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Control of Wind Erosion

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16. ABSTRACT

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STATE OF CALIFORNIA—TRANSPORTATION AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
MATERIALS AND RESEARCH DEPARTMENT
5900 FOLSOM BLVD., SACRAMENTO 95819

December 1971
Lab Auth 642118

R. J. Datel
State Highway Engineer

Dear Sir:

Submitted herewith is a research report titled:

CONTROL

OF

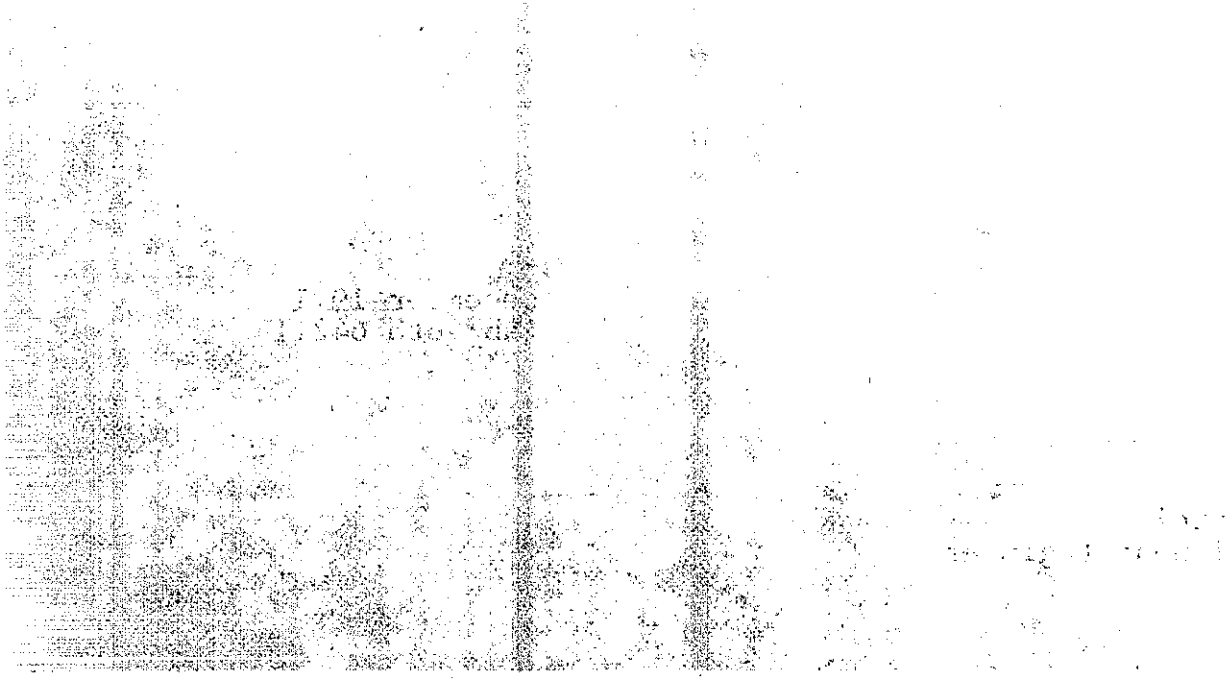
WIND EROSION

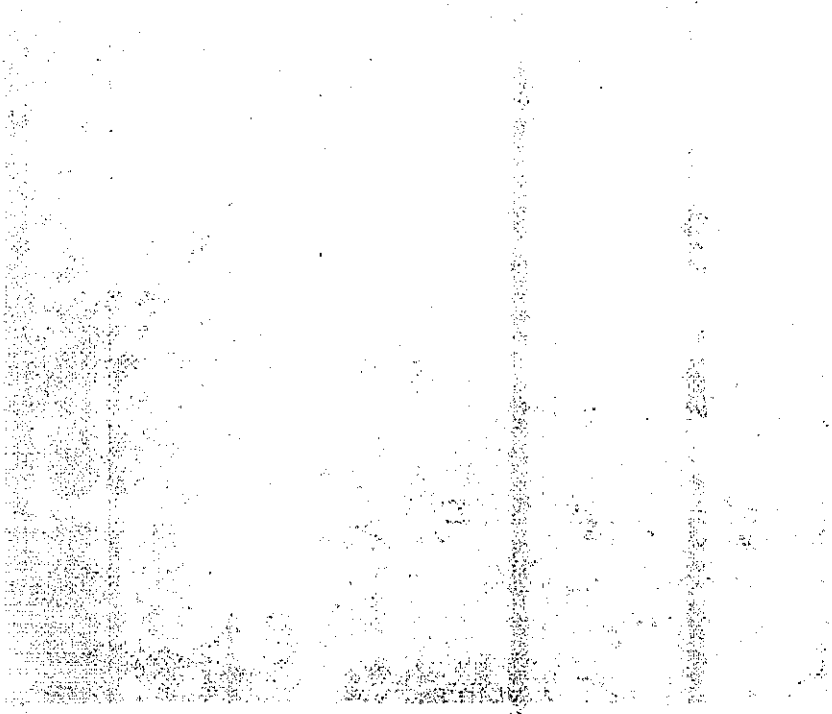
Travis Smith
Principal Investigator

Ronald Mearns and Carl Crawford
Co-Investigators

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer





REFERENCE: Smith, Travis; Mearns, Ronald; and Crawford, Carl. "Control of Wind Erosion," State of California, Department of Public Works, Division of Highways, Materials and Research Department, December, 1971, Research Report Number 642118.

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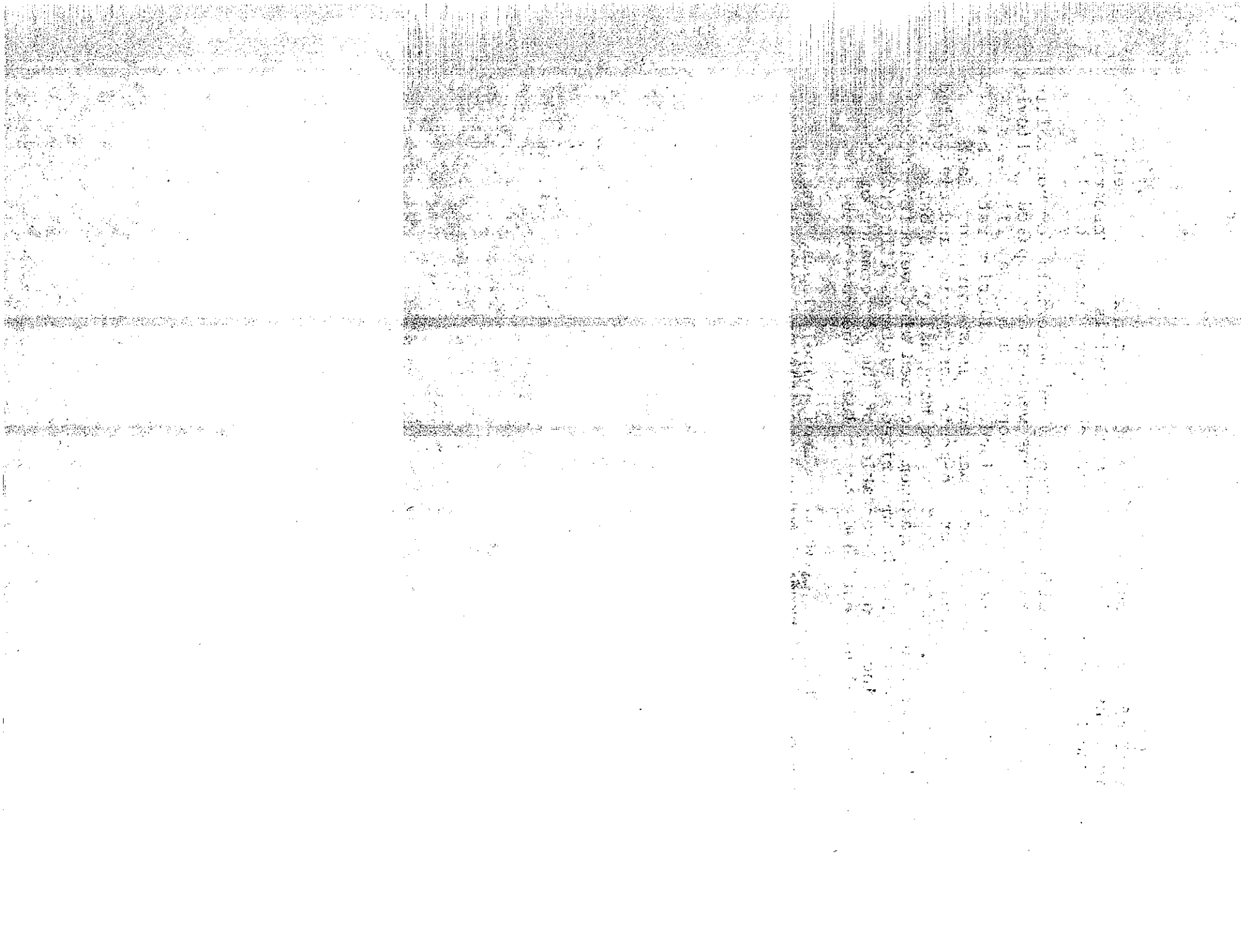

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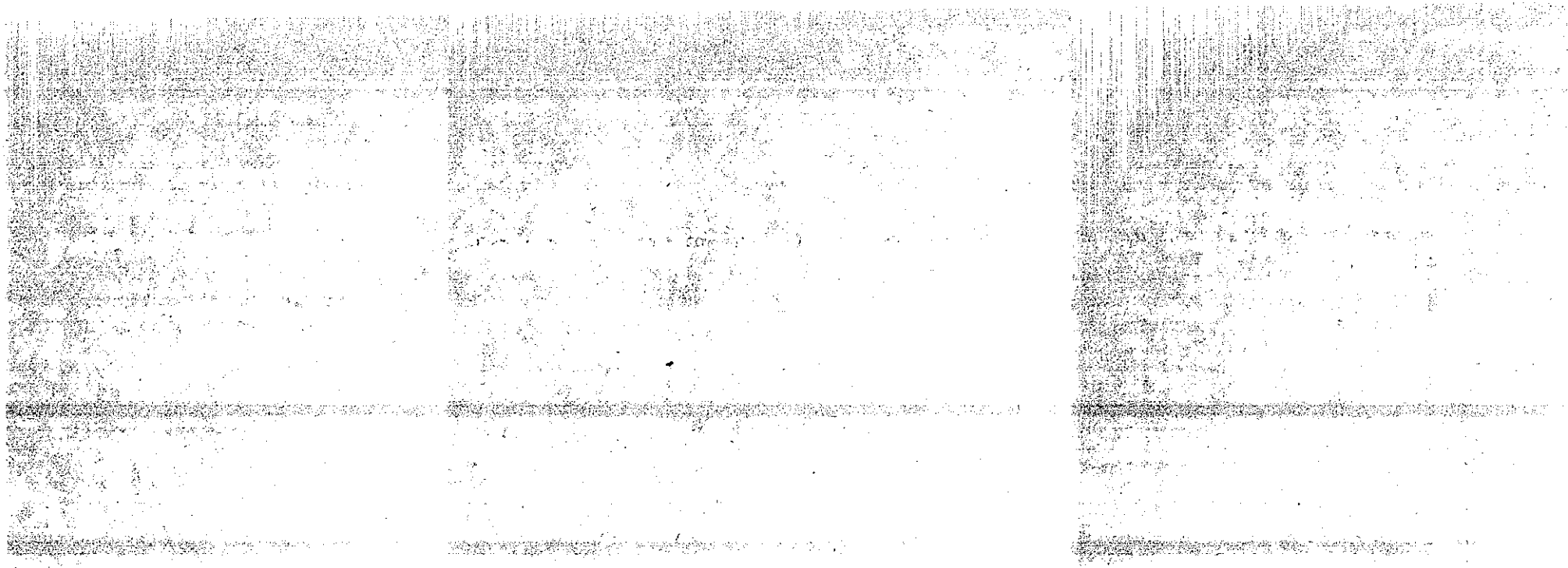

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Introduction

Erosion caused by wind is a problem in the desert areas of southern and eastern California, in some areas along the Coast, and locally in areas where high winds and fine-grained unconsolidated soils occur together. Frequently problems caused by wind erosion are encountered during or after construction of a highway. These problems are: serious erosion of fills necessitating reconstruction, damage to highway structures, signs and vehicles due to sand blasting by strong winds and, most important, the safety hazard created by serious reduction of visibility caused by blowing sand. In addition to these problems which have always been present, there now exists problems resulting from recently enacted legislation which makes it illegal to be responsible for unnatural pollution of air, land or water.

In the past, the California Division of Highways has tried such methods for controlling wind erosion as sand fences, appropriately oriented rows of trees, careful selection of alignment, and surface treatments such as asphalt or gravel blankets. Each of these methods has worked under certain conditions. The gravel blanket, although expensive, appears to be adaptable to nearly all conditions.

This study was conducted to evaluate the effectiveness of several of the "spray-on" materials. These materials have come on the market recently and are represented as being capable of controlling erosion. This report describes the test, its results and includes data on the costs of the materials.

The area selected for this test is on a realignment portion of Road 11-Riv-10 which bypasses the community of Indio (Contract No. 11-037514). This area, although not subject to the high velocity winds found a few miles to the west, does have severe winds especially in the spring. Approach fills, during construction, experienced severe damage and some complaints were received from local residents about the blowing sand. The contract called for straw to be punched into the cleared areas and fill slopes to prevent erosion. The Resident Engineer didn't feel this would be adequate and changed to a gravel blanket to be placed on the windward slopes and on exposed areas. The gravel blanket, as previously mentioned is completely adequate to protect against wind erosion, however, it was expensive, costing approximately $2500 per acre in place. Because of this expense and several approaches by vendors with products which were less expensive and represented as satisfactory, it was decided to test a number of the products.

The test plots to which the products were applied are located on the northeast facing slope of the north approach fill to the North Indio on-ramp overcrossing. The slope angle is 2:1. Each test plot is 25 feet high and 15 feet wide, and is completely surrounded by a gravel blanket to prevent undercutting of the

edges of the test plot by wind erosion. The appearance of the test plots can be seen in Plates 1, 2, 3 and 4.

The test plots were constructed by placing the gravel blanket and then clearing the area for the test plot. This work was accomplished with a gradall. After the test applications were completed, a gravel blanket was placed across the toe of the slope using a motor grader. Slope preparations are pictured in Plates 5, 6, and 7.

The fill on which the test plots are located was constructed from fine-grained rounded sand which was imported from a borrow area in a sand dune. Laboratory analysis of samples from the test plots indicate no significant variation either in mineral content or grain size.

All products except Aquatain, Glenkote and Soil-Lok were mixed and applied by personnel of the Materials and Research Department. The trailer-mounted sprayer shown in Plate 8 was used by the Materials and Research personnel. The tank has a 150-gallon capacity, which was more than adequate for the size of the test plots. Five-gallon intervals were marked on the inside of the tank to facilitate the proportioning operations in the field. A continuous, vigorous agitation system is built into the sprayer to assure delivery of a uniform mixture through the spray nozzle. The centrifugal pump is driven by a 7½-HP Briggs and Stratton 4-cycle gasoline engine.

The proportioning, mixing and spraying operations were efficient and trouble free. Two problems were experienced with the sprayer, both of which have subsequently been corrected by the manufacturer. The first problem was the small size of the pump which delivered insufficient pressure at the nozzle. This problem was overcome by using a nozzle with a much smaller orfice. The second problem was the agitation system which resulted in making a frothy mixture of the plastic materials. This froth would not penetrate the soil and an antifoaming agent had to be added to the sprayer to prevent formation of the froth.

Aquatain was applied by the vendor using the sprayer shown in Plate 9. Soil-Lok was applied by the vendor using the equipment shown in Plate 10. Glenkote was applied by the vendor six weeks after the other applications and no pictures of the equipment were obtained.

To properly interpret the results of this study, it was necessary to have knowledge of the wind velocity and direction. The continuous recording system shown in Plate 11 was used to obtain the data. The system was installed at the Resident Engineer's office, about 1/4 of a mile from the test plots, to reduce the possibility of vandalism and to assure that malfunctions could be detected and repaired quickly to minimize the loss of data. Wind velocity data is summarized in Table 3. The winds generally are from the north or northwest and therefore blow across the test plots instead of at them.

Results

A total of 16 products were included in this test. The chemical materials tested were Aerospray 52, Curasol AE, Curasol AH, Erode-X, Glenkote, Soilmaster, Soil Seal, Soil-Lok, Surfaseal and Terra-Krete. The organic materials tested were Aquatain, Coherex, Conwed Fiber, Ecology Control, Orzan and Verdyol (Super).

The results of this study, summarized in Table 4, show that eight of the products performed satisfactorily. These eight products are Conwed Fiber, Curasol AE, Curasol AH, Orzan, Soil Seal, Soil-Lok, Surfaseal and Terra-Krete. The performance of each of the other products were judged either marginal or unsatisfactory.

It must be stressed that the evaluations obtained in this study are quite specific, that is they are valid only for the severity of the last windy season, for the orientation of the test area, for the type of material in the test area and especially only for the concentration and application rates used in these tests.

Observation of these test plots will continue for several seasons. A supplemental report will then be prepared which will give some indication of the life expectancy of the materials under the test conditions. Two products, Orzan and Soil-Lok, appear to have the potential for successful performance for several seasons.

Those products which performed satisfactorily should be tested further to determine the limits of their usefulness. The other products should not be tested at State expense until the vendors can show a successful test application with controls that will permit meaningful evaluation and which suggests a reason for the poor performance on this test.

Test Procedure

Figure 1 is a diagram of the test plot layout, provides data on the cut slope characteristics, and lists the material applied to each test plot.

The control plot, shown in Plate 12, was left untreated as a basis for comparison to the performance of the materials being tested. The surface of this control plot was sprinkled with water and a very weak crust did form. The blowing sand quickly destroyed this crust and most of the fine material on the test plot was subsequently blown away. As can be seen in Plate 12, a motorcycle was driven up the left side of this test plot.

Each material tested, except Conwed Fiber, Curasol AH and Glenkote, was applied to two test plots to assure that a local problem would not limit our ability to evaluate performance. In actual fact this precaution was unnecessary and the performance of each material was identical on both test plots.

Because of the arid climate, no seeding of the test plots was planned or performed as part of this study.

Materials

The products included in this study are listed in Table 1 with the name of the vendor who supplied the material, the technical assistance for the application, and the cost data. Table 2 shows the dilution and application rates recommended by the vendors for these tests. Table 2 also includes, for comparative purposes, the costs per acre for each of the materials. The material costs shown generally do not include shipping costs and are based on prices in effect during September 1971. The price of Aquatain includes shipping to any place in the United States and the company would not quote a price that did not include shipping. The costs shown in Table 2 do not include the cost of application.

The materials tested on this project can be divided into two major types, chemical and organic. The chemical materials included in this test are; Aerospray 52, Curasol AE, Curasol AH, Erode-X, Glen Kote, Soilmaster, Soil Seal, Soil-Lok, Surfaseal and Terra-Krete. There is no reliable information on the service life of any of these materials. All of these materials supposedly prevent erosion, are nontoxic and nonwater soluble.

The organic materials used in this test are Aquatain, Coherex, Conwed Fiber, Ecology Control, Orzan, and Verdyol (Super). These products deteriorate to some extent when exposed to weathering, and probably contribute nutrients to the soil.

Although the test plots were not planted some native seed did germinate (See Plate 13). These plants grew primarily on the control plot and in the gravel blanket. Several plants grew on the Glenkote plot but probably germinated during the six-week interval between the other treatments and the Glenkote treatment. One plant sprouted on one of the test plots of both Aerospray 52 and Curasol AH. It appears that all treatments inhibit natural revegetation.

The test plots were numbered for purposes of describing and analyzing the performance of the test plots. The evaluations were matched up with product names after completion of the evaluations. The evaluations were made by personnel of the Materials and Research Department and are summarized in Table 4.

Insects have excavated burrows (Plate 14) in nine of the test plots. These burrows appear to be independent of the treatment materials and have not affected the performance so they were not considered in making the evaluations.

The following discussions of each of the materials describes our experiences under the test conditions.

Aerospray 52

Aerospray is a white, viscous alkyd resin dispersed in water. It has no strong odor and was easy to handle and clean up. The test plots were premoistened before applying the diluted solution. After drying, Aerospray 52 left a colorless, thin, hard crust. Plates 15 and 16 show the test plots treated with Aerospray 52.

The performance of Aerospray 52 was judged marginal because the blowing sand had severely scoured the surface of the test plots and had locally cut through the crust. It should be noted that one plant did grow in one of the Aerospray test plots. This agrees with previous observations and suggests that Aerospray 52 may not be as severe in inhibiting germination as most other products tested in this study.

Aquatain

Aquatain is a liquid concentrate of water soluble chemicals and pectin. It has no strong odor and was easy to use. A bright green dye has been added to Aquatain so that the spray operator can visually control the uniformity of the application. While the dye does perform its intended function, it stains skin, clothing and equipment and makes cleanup difficult. On the slope, the color fades rapidly from the bright green to a very light dull green.

The test plots were premoistened before applying the diluted solution. After drying Aquatain formed a thin fragile crust. Plates 17 and 18 show the test plots treated with Aquatain.

The performance of Aquatain was judged unsatisfactory because blowing sand had completely abraded the crust away and the wind subsequently stripped most fine material from the test plot.

Coherex

Coherex is a stable, concentrated, nonvolatile emulsion of semi-liquid natural petroleum resins in a wetting solution. It has no strong odor and is easy to use. Because of the oil base it was slightly harder to clean up than most of the other products, however, it did clean up and created no problems in the equipment. It has a light brown color which is imparted to the

slope and does not appear to fade much after exposure. This material does not dry into a crust, but forms a flexible bond between sand grains which appears to weaken after exposure to weather. Plates 19 and 20 show the test plots treated with Coherex.

The performance of Coherex was judged marginal because while the flexible surface did not strip away it was penetrated by the blowing sand largely because of limited penetration by the Coherex emulsion.

Conwed Fiber

Wood fiber manufactured from white ash by the Conwed Corporation of St. Paul, Minnesota, was tested on one of the test plots on this project. The fiber was applied at a rate of 3000 pounds per acre which is twice the rate normally used. The violent agitation provided by our sprayer was essential in obtaining uniform dispersal of the fibers in the mixing water and to assure a reasonably uniform application. This material has no odor and is easy to use and clean up. The initial mixing was more time consuming than with the liquids because the fiber had to be added to the mixer gradually to assure mixing and prevent plugging of the pump. The fiber has a light green color which fades very slowly when exposed to sunlight. After drying, this material developed a continuous flexible surface over the entire test plot. Plate 21 shows the test plot treated with Conwed Fiber.

The performance of Conwed Fiber was judged satisfactory because it showed absolutely no sign of distress. The reason for this performance was the development of a thin sand blanket which formed over the fiber and which neither blew away nor became thicker.

Curasol AE

Curasol AE is a white viscous polymer dispersion. It has a very strong odor and is easy to use. This material adheres to everything with which it comes in contact and, unless everything is thoroughly washed very quickly, cleanup becomes difficult. The diluted solution was applied to a premoistened slope and dried to a colorless thin hard surface. Plates 22 and 23 show the test plots that were treated with Curasol AE.

Curasol AE performed satisfactorily because although the surface was scoured by blowing sand it was not penetrated.

Curasol AH

The comments on nature, appearance, use and difficulty of cleanup made in reference to Curasol AE all apply to Curasol AH. The difference between Curasol AH and all of the other plastic materials is that the surface formed is slightly thicker and is not hard and brittle. This surface flexibility appears to be desirable on soft surfaces such as uncompacted embankment slopes. Plate 24 shows the appearance of the test plot treated with Curasol AH.

The performance of Curasol AH was judged satisfactory because although scoured by blowing sand, the surface was not penetrated. One plant grew on the Curasol AH test plot at the southeast edge. This particular plant appears to have started in an accumulation of blow sand and the roots then penetrated the Curasol surface.

Ecology Control

Ecology control is a brown powder of unknown composition. It did not appear to be totally water soluble and agitation was required during the application. Ecology Control had no strong odor and was very easy to use and clean up. After drying, the test plot had a colorless, thin hard surface. Plates 25 and 26 show the test plots treated with Ecology Control.

The performance of Ecology Control was judged unsatisfactory because blowing sand had severely scoured the surface and had penetrated the surface over most of the area of both test plots.

Erode-X

Erode-X is a white viscous concentrate of an unknown plastic material which must be diluted with water before application. It has no strong odor and is easy to use and clean up. It dries to a colorless hard thin surface. Plates 27 and 28 show the test plots treated with Erode-X.

The performance of Erode-X was judged marginal because blowing sand had severely scoured the surface and had locally penetrated the surface.

Glenkote

Glenkote was developed for sealing rock roofs. It is a plastic material of unknown composition. It has no strong odor and is easy to use and clean up. It dried to a colorless thin hard surface. Plate 29 shows the test plot treated with Glenkote.

The performance of Glenkote was judged marginal because blowing sand had severely scoured the surface and locally had penetrated it.

Orzan

Orzan is a dark brown extremely viscous solution of chemicals and liquin sulfonate. It has a strong odor and is very easy to use and clean up. The dark color of this material did cause a discoloration of the test plot. Orzan exhibited remarkable penetration which resulted in a hard surface approximately three inches thick. This material also developed deep shrinkage cracks which did not interfere with performance but which are unsightly. Plates 30 and 31 show the test plots treated with Orzan.

The performance of Orzan was judged satisfactory because the surface was not damaged at all. The color and shrinkage cracks are definite disadvantages that should not be forgotten.

Soilmaster

Soilmaster is a water dispersion of epoxies and silicones. It has no strong odor and was easy to clean up. It was somewhat more difficult to use than most of the materials because it comes as two components which are added to the mixing water separately and require waiting periods after the addition of each component. It is applied to a premoistened surface and dries to a colorless, thin, fragile crust. Plates 32 and 33 show the test plots treated with Soilmaster.

The performance of Soilmaster was judged marginal because blowing sand had severely scoured the surface and locally had penetrated it.

Soil Seal

Soil Seal is an emulsion of copolymer materials which can be diluted with water. It has no strong odor and is easy to use and clean up. It dries to a thin hard surface. Plates 34 and 35 show the test plots treated with Soil Seal.

The performance of Soil Seal was judged satisfactory because although the surface had been scoured by blowing sand it had not been penetrated.

Soil-Lok

Soil-Lok is sodium silicate (water glass) that is hardened with a subsequent application of calcium chloride. The result of this type of treatment was the development of a thick (up to 1/2 inch) extremely hard surface which will probably prevent development of vegetation and should have a service life of several years. Special equipment and handling are required for this type of application and the vendor provided what was necessary. The test plots were premoistened with water, then

saturated with sodium silicate and finally chemically hardened with calcium chloride. Plates 36 and 37 show the test plots treated with Soil-Lok.

The performance of Soil-Lok was satisfactory and the surface was not damaged at all.

Surfaseal

Surfaseal is a white viscous plastic of unknown composition. It has no strong odor and is easy to clean up. It is more difficult to use than the other plastics because the recommended method of application required three passes with intervening time to permit drying of the previous pass. This was not a problem for our test but on a large job would be more difficult and expensive. Plates 38 and 39 show the test plots treated with Surfaseal.

The performance of Surfaseal was judged satisfactory because, although scoured by blowing sand, the surface was not penetrated.

Terra-Krete

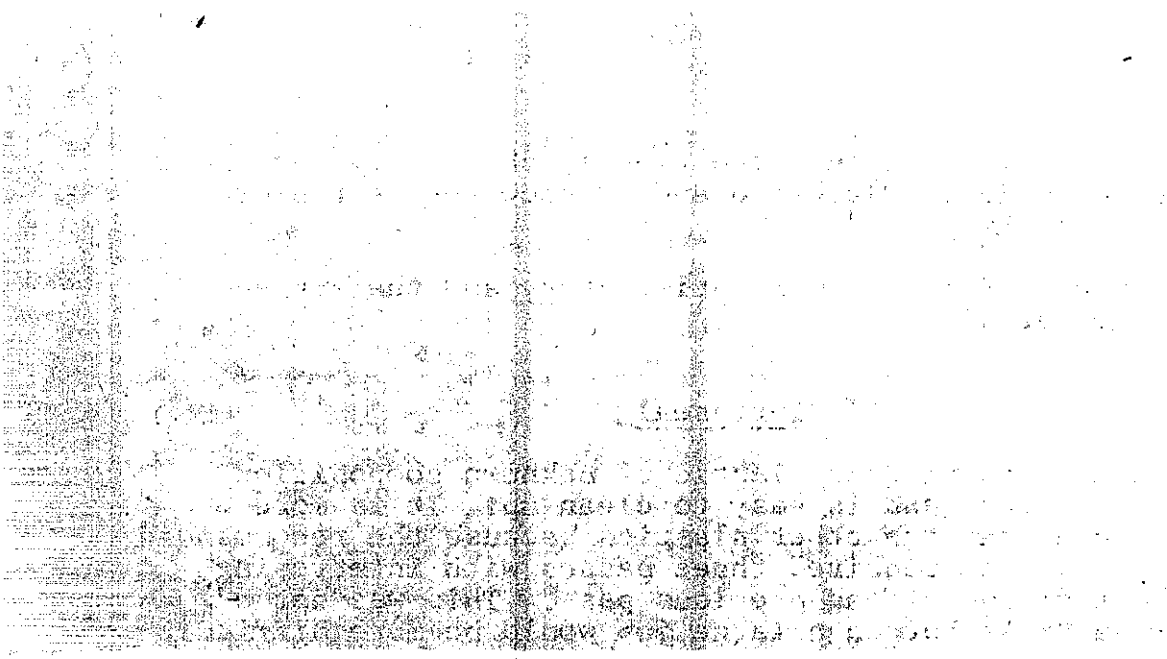
Terra-Krete is a very light green, slightly viscous solution of chemicals in a latex base. It has no strong odor and is easy to use and clean up. It dries to a colorless thin hard surface. Plates 40 and 41 show the test plots treated with Terra-Krete.

The performance of Terra-Krete was judged satisfactory because the blowing sand which scoured the surface did not penetrate it.

Verdyol (Super)

Verdyol is a brown granular material that is not entirely water soluble and therefore requires agitation during application. The composition of this material is unknown, but it is organic and it has a slight odor similar to some kinds of fertilizer. Verdyol is easy to use and clean up. It drys to a colorless very thin hard surface. Plates 42 and 43 show the test plots treated with Verdyol.

The performance of Verdyol (Super) was judged unsatisfactory because the surface was completely destroyed and most fine material on the test plots has blown away.



Product Name	Vendor	Telephone
Aerospray 52	Gene Thouvenell P.O. Box 283 Upland, CA 91786	714-985-5775
Aquatain	Don Keller 1440 S. Allec St. Anaheim, CA 92805	714-635-4770
Coherex	Bill Canessa P.O. Box 378 Bakersfield, CA 93302	805-399-9501
Conwed Fiber	Richard Carlyon 751 N. Edwards Dr. Carson City, Nev. 89701	702-882-2055
Curasol AE	Gordon Christensen P.O. Box 975 Placerville, CA 95667	916-622-6030
Curasol AH	Same as Curasol AE	
Ecology Control	Jack Hatton 5275 Craner Ave. No. Hollywood, CA 91601	213-985-2807
Erode-X	Walt Stanley 946 E. Tunnell St. Santa Maria, CA 93454	805-925-3244
Glenkote	Sterling Tracy 1001 Glendale Blvd. Los Angeles, CA 90026	213-380-4124
Orzan	Joe Otnes Suite 621 Leatherby Bldg. 1400 No. Harbor Blvd. Fullerton, CA 92632	213-694-2149
Soilmaster	John Kennedy 7554 Clybourn Ave. Sun Valley, CA	213-767-5811
Soil Seal	Robert Korf 6311 Rutland Ave. Riverside, CA 92503	213-380-2050

Table I. Products Tested

Product Name	Vendor	Telephone
Soil-Lok	Patrick McCullough P.O. Box 2111 Santa Fe Springs, CA 90670	213-941-0231
Surfaseal	Ed Graf 1680 Bryant St. Daly City, CA 94015	415-992-5520
Terra-Krete	Tom James 12740 Matteson Ave. Los Angeles, CA 90066	213-397-1384
Verdyol (Super)	Same As Ecology Control	

Table I. Products Tested

Product	Dilution Rate gals/lbs:gals H_2O	Application Rate gals. Mixture per Acre	Material Cost Per Acre
Aerospray 52	1:15.5	4742	$ 819.00
Aquatain	1:5.5	1133	550.00
Coherex	1:4	3485	287.28
Conwed Fiber	1#:3	11,616	390.00
Curasol AE	1:40	4763	359.04
Curasol AH	1:40	4763	401.28
Ecology Control	1:16.5	2904	208.08
Erode-X	1:9	2323	2378.75
Glenkote	1:4	1452	871.50
Orzan	1:1	11,616	670.48
Soilmaster	1A and 1B:20	6389	3960.00
Soil Seal	1:25	6040	837.50
Soil-Lok	-	10,000	3200.00
Surfaseal	1:1	1162	252.00
Terra-Krete	1:25	7248	1275.00
Verdyol (Super)	1:40	4646	293.48

Table 2. Product Technical Data and Costs

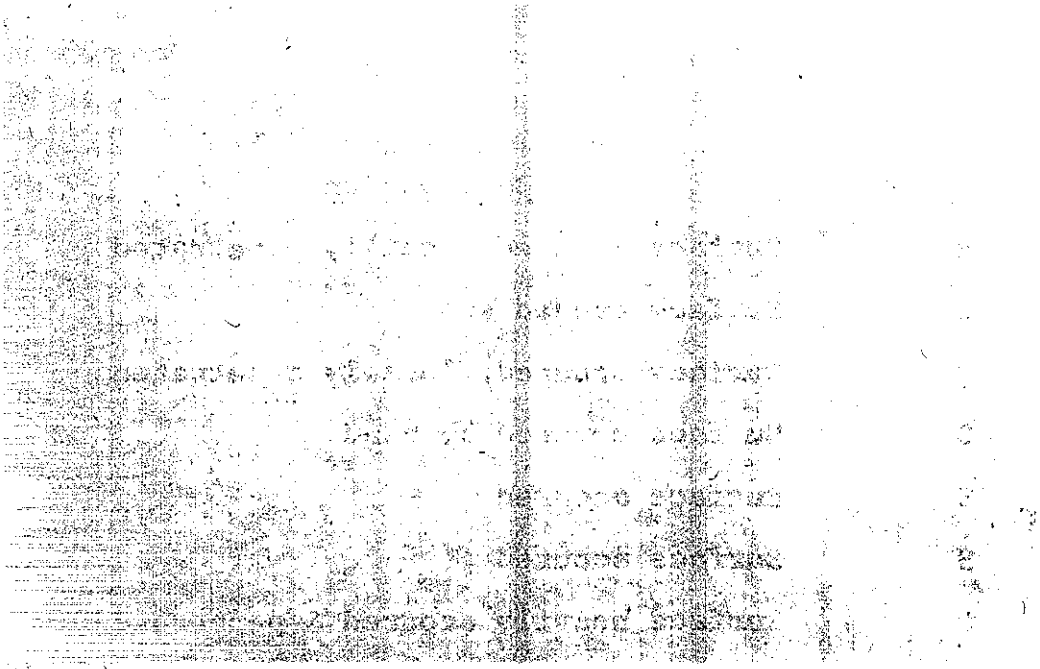
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
March	33	15	13	24	31	8	10	19	15	23	22	23	44	14	12	12	18	20	18	16	21	9	22	24	16	46	45	20	11	24	24
April	9	12	26	10	12	22	26	32	12	15	22	14	16	28	16	40	42	23	39	48	29	18	22	28	22	18	28	23	23	14	/
May	18	--	--	--	26	26	20	20	21	24	14	19	19	23	25	24	28	10	18	22	34	26	0	0	0	0	0	0	--	--	--
June	--	--	21	16	18	24	24	21	35	29	28	17	16	12	28	28	19	39	36	40	25	14	20	27	--	--	--	--	17	16	/
July	22	19	14	20	22	16	15	15	19	14	14	17	16	14	16	18	10	17	18	12	14	19	15	14	20	24	18	14	16	18	14
Aug.	24	15	15	21	14	12	10	11	10	21	14	14	15	18	10	14	12	12	12	16	16	12	18	11	12	12	16	10	13	12	--

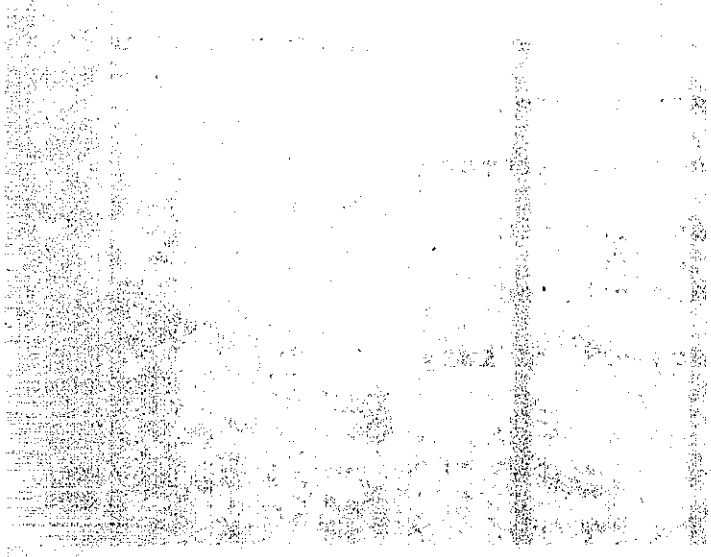
Table 3. Maximum Recorded Wind Velocity
For Each Day of Test Period

Product Name	Quality*	Observations
Aerospray 52	M	Surface scoured, locally penetrated
Aquatain	U	Surface eroded away
Coherex	M	Surface scoured, locally penetrated
Conwed Fiber	S	Surface covered by sand
Curasol AE	S	Surface scoured
Curasol AH	S	Surface scoured
Ecology Control	U	Surface heavily scoured & penetrated
Erode-X	M	Surface scoured, locally penetrated
Glenkote	M	Surface scoured, locally penetrated
Orzan	S	Surface discolored, with cracks
Soilmaster	M	Surface scoured, locally penetrated
Soil Seal	S	Surface scoured
Soil-Lok	S	Surface Undisturbed
Surfaseal	S	Surface scoured
Terra-Krete	S	Surface scoured
Verdyol (Super)	U	Surface eroded away

Table 4. Summary of Results

*S - Satisfactory
M - Marginal
U - Unsatisfactory





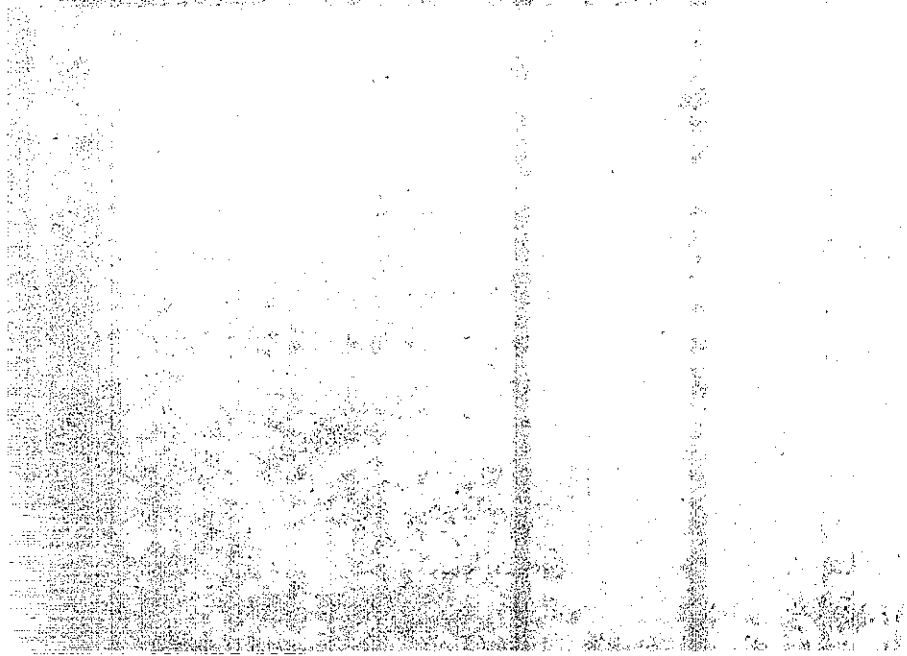


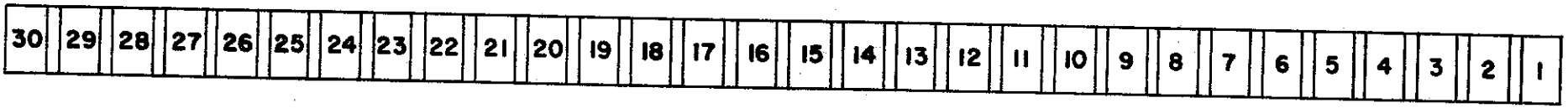
FIGURE I

Wind Erosion
Test Plots

1" = 60'

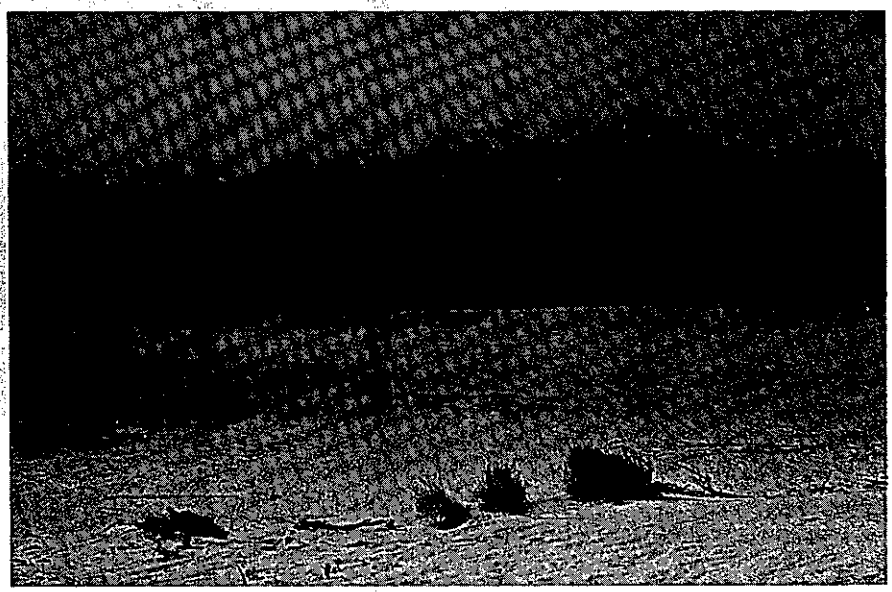
N66W →

Slope Angle 2:1

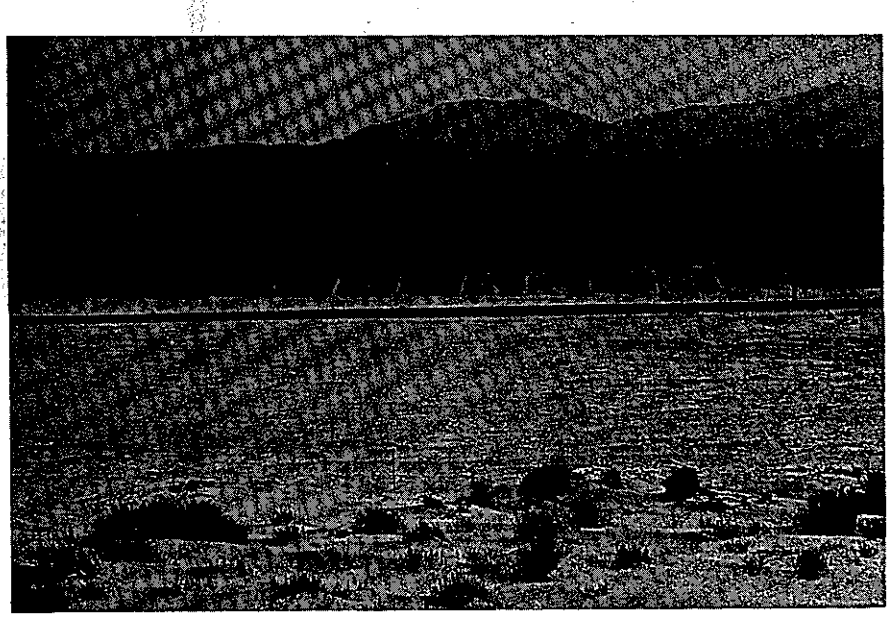


1. Surfaseal
2. Erode-X
3. Surfaseal
4. Erode-X
5. Soil Seal
6. Control
7. Soil Seal
8. Soilmaster
9. Aquatain
10. Soilmaster
11. Curasol AE
12. Soil-Lok
13. Curasol AE
14. Orzan
15. Aquatain
16. Orzan
17. Terra-Krete
18. Soil-Lok
19. Terra-Krete
20. Conwed Fiber
21. Coherex
22. Ecology Control
23. Coherex
24. Verdyol (Super)
25. Ecology Control
26. Aerospray 52
27. Verdyol (Super)
28. Aerospray 52
29. Glenkote
30. Curasol AH

Plate 1 - Overall view of test area on March 5, 1971. Seven test plots are located beyond the plot at the edge of the photograph.

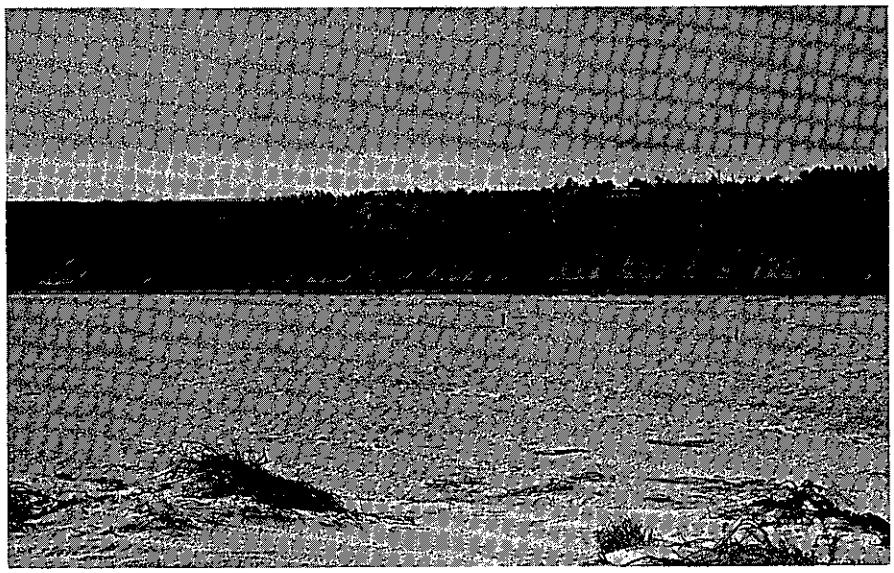


Test plots 1 through 15 (from right to left) on March 5, 1971.



Test plots 2 through 16 on August 30, 1971.

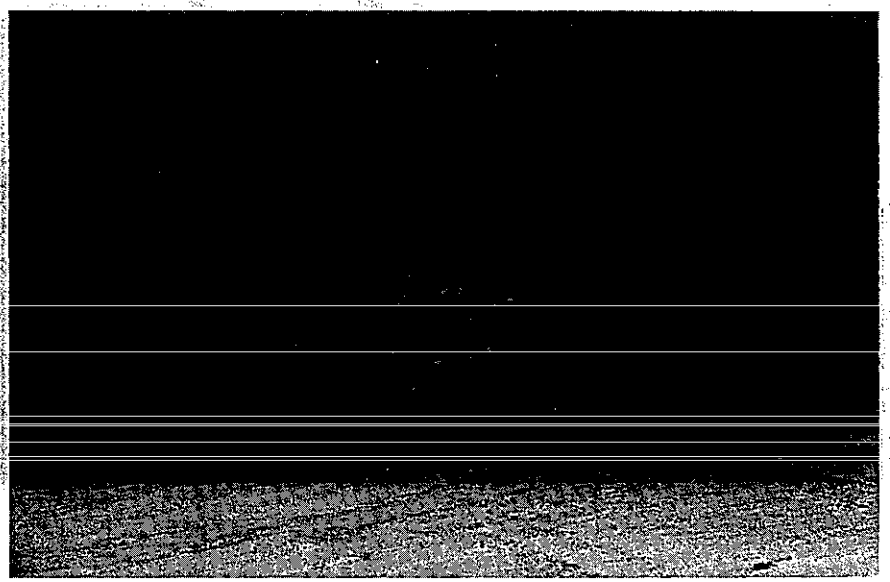
Plate 2



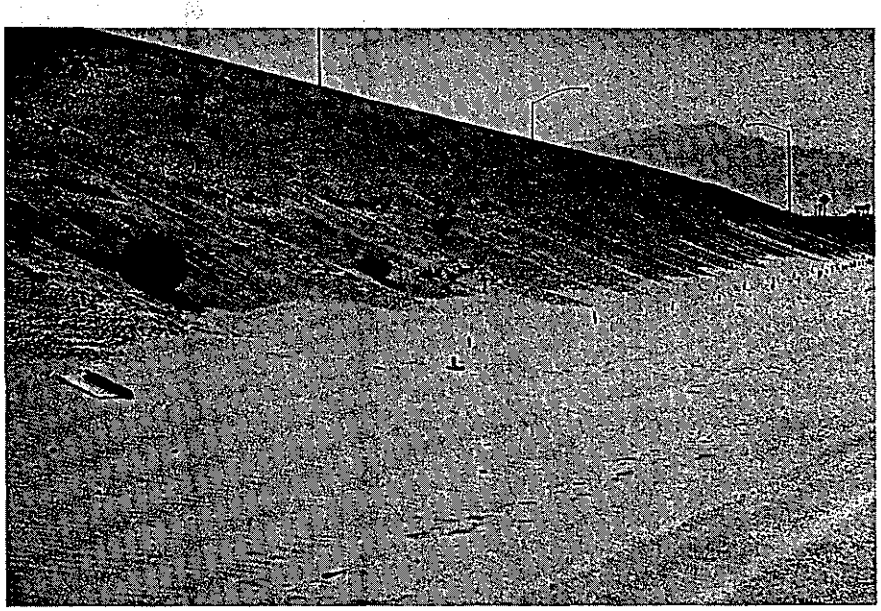
Test plots 16 through 30 (from right to left) on March 5, 1971.

Test plots 13 through 30 on August 30, 1971.

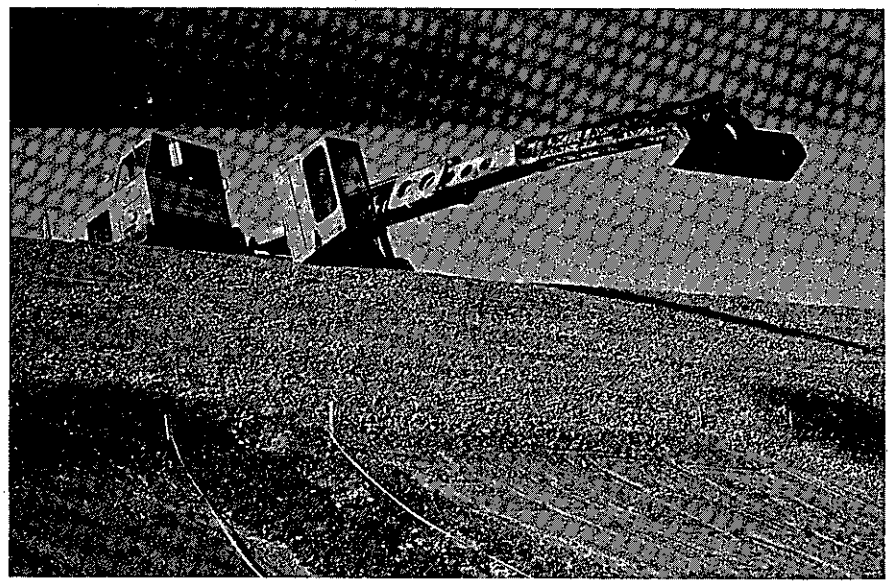
Plate 3



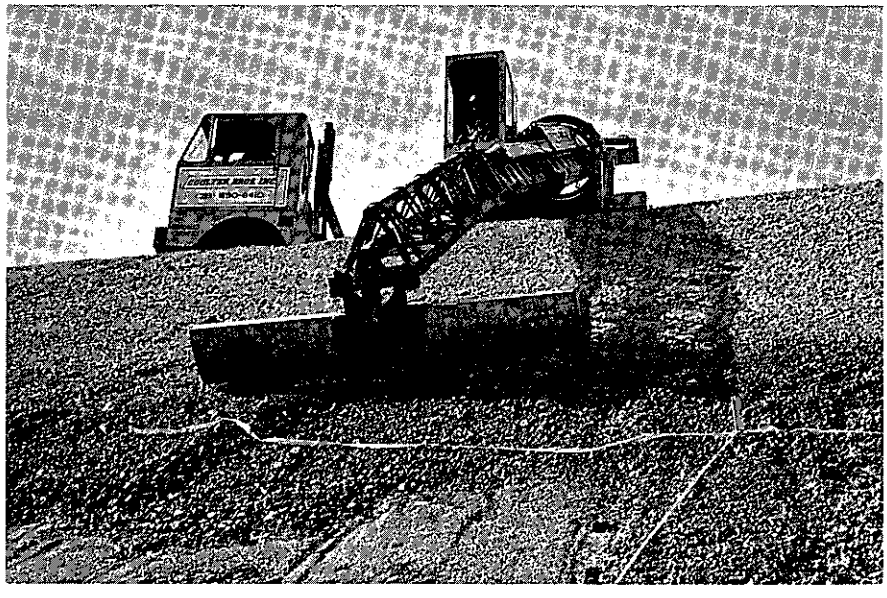
Test area (looking southeast) on August 30, 1971.



Test area (looking northwest) on August 30, 1971.

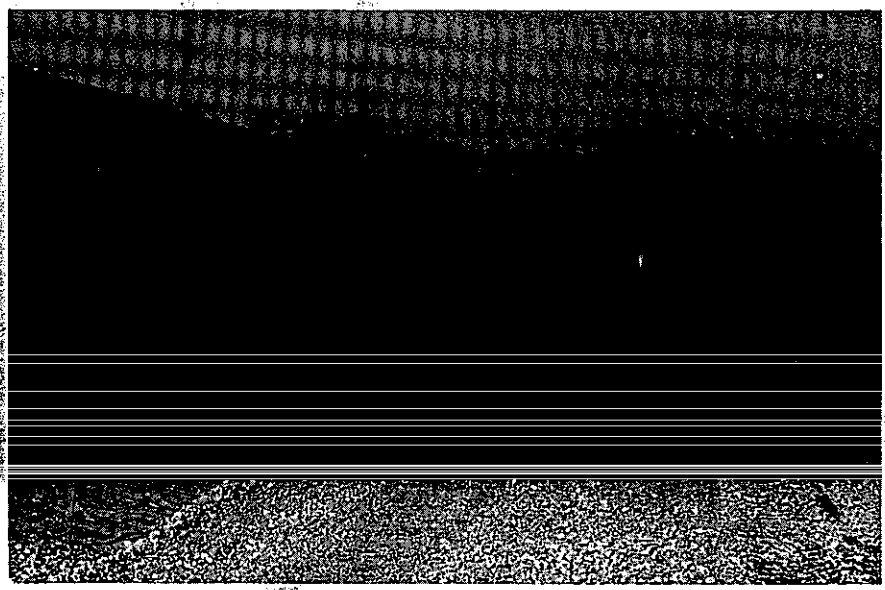


3-5-71



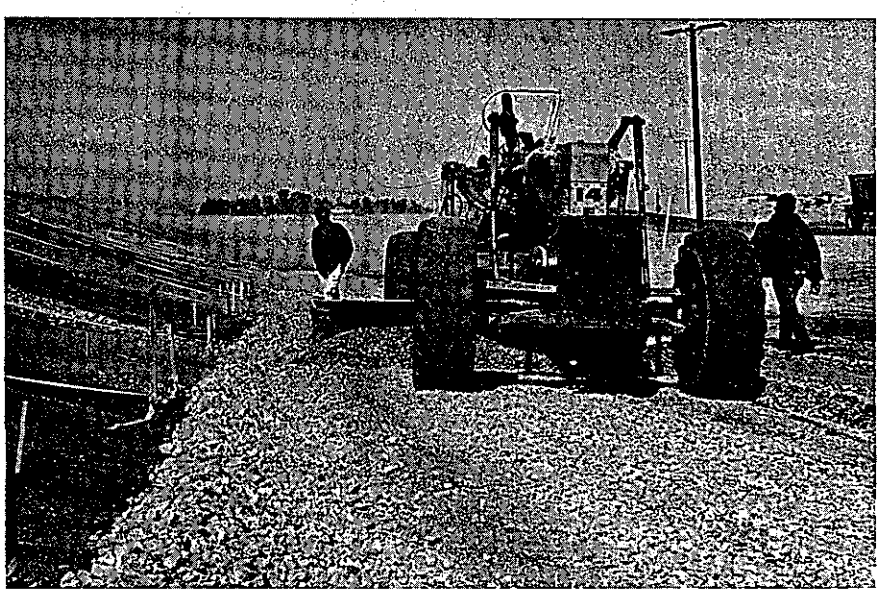
3-5-71

Plate 5 - Gradall dressing slopes above test plots. All test plots were prepared with this gradall.



3-5-71

Gradall dressing slopes above test plots and motor grader installing gravel blanket at base of test plots.



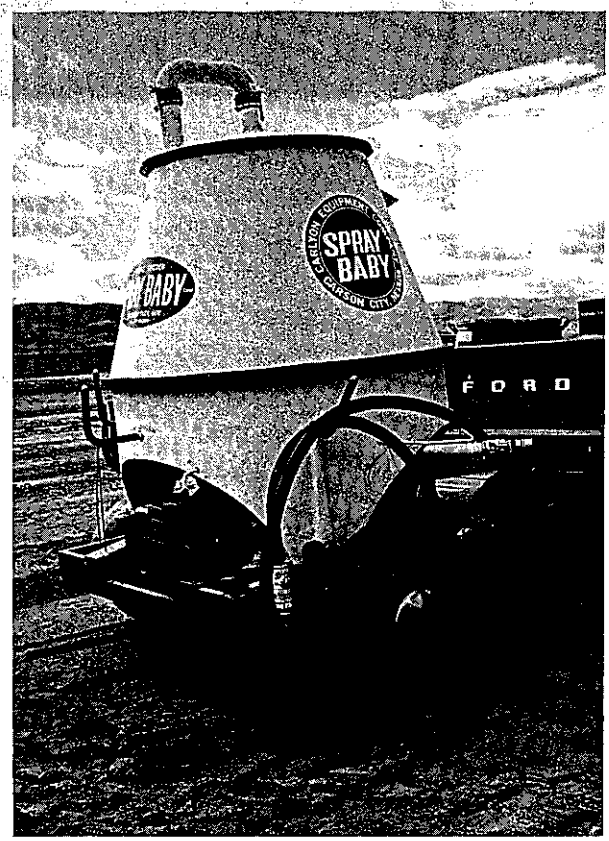
3-5-71

Motor grader installing gravel blanket at base of test plots.

Plate 6

3-5-71

Plate 7 - Motor grader installing gravel blanket at base of test plots. Note clouds of sand migrating from bare land on the opposite side of the road. The wind was about 27 mph with gusts up to 34 mph.



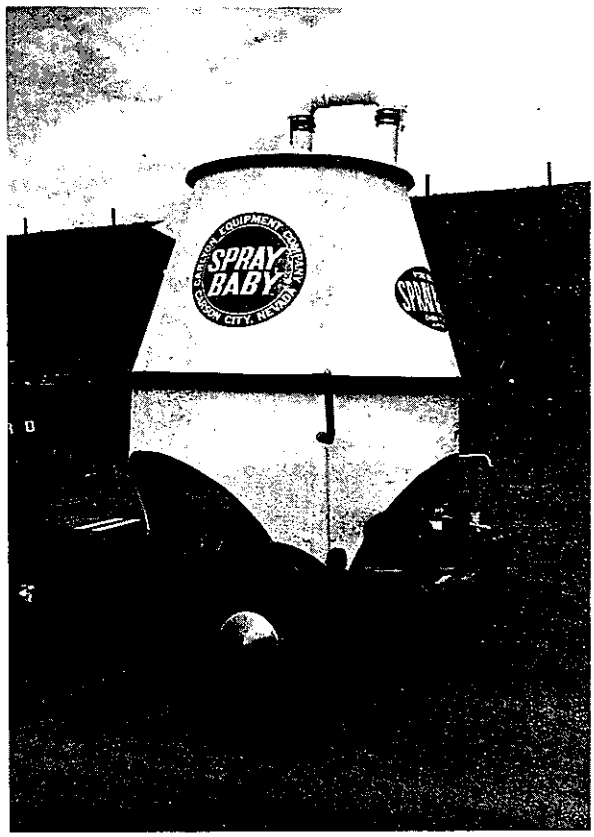
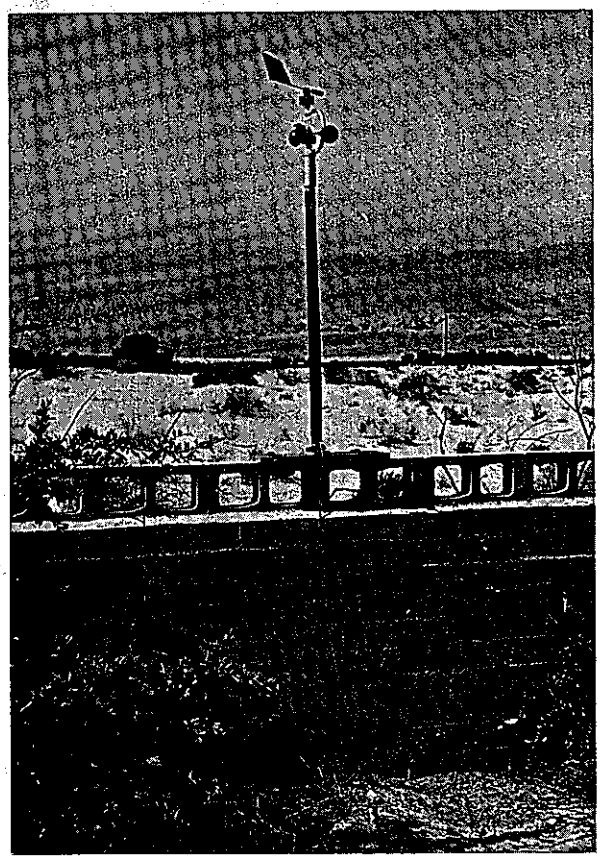


Plate 8 - Rental Hydromulch sprayer used for applying most materials.

Plate 9 - Sprayer used for applying Aquatain.

Plate 10 - Sprayer used for applying Soil-Lok.



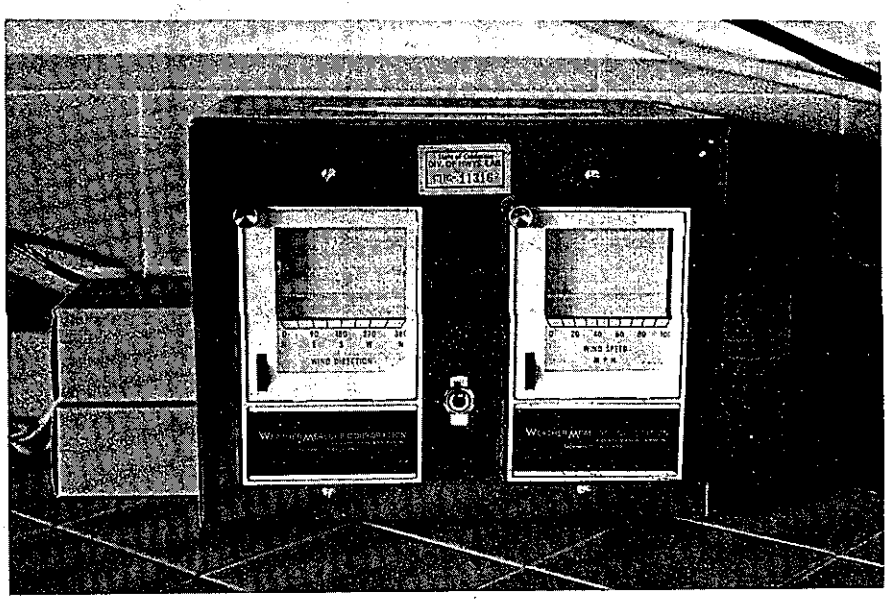
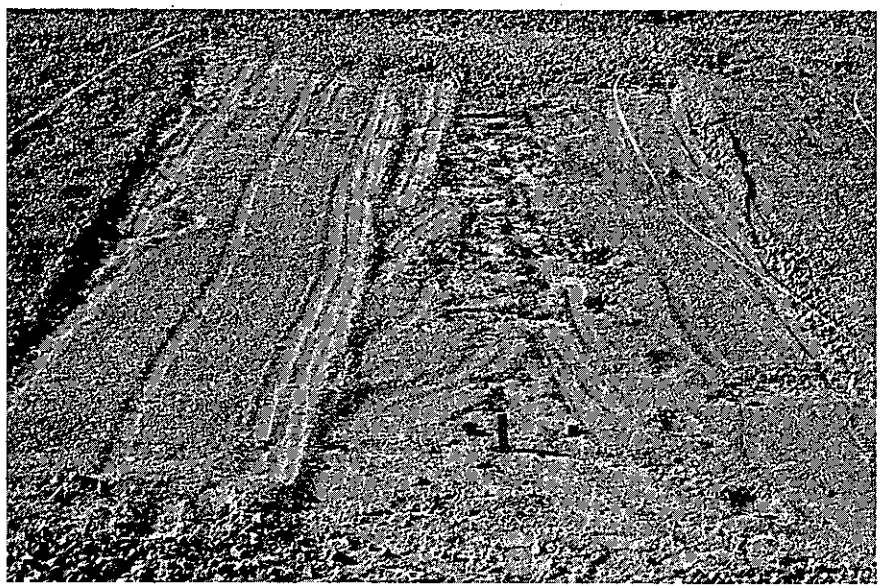
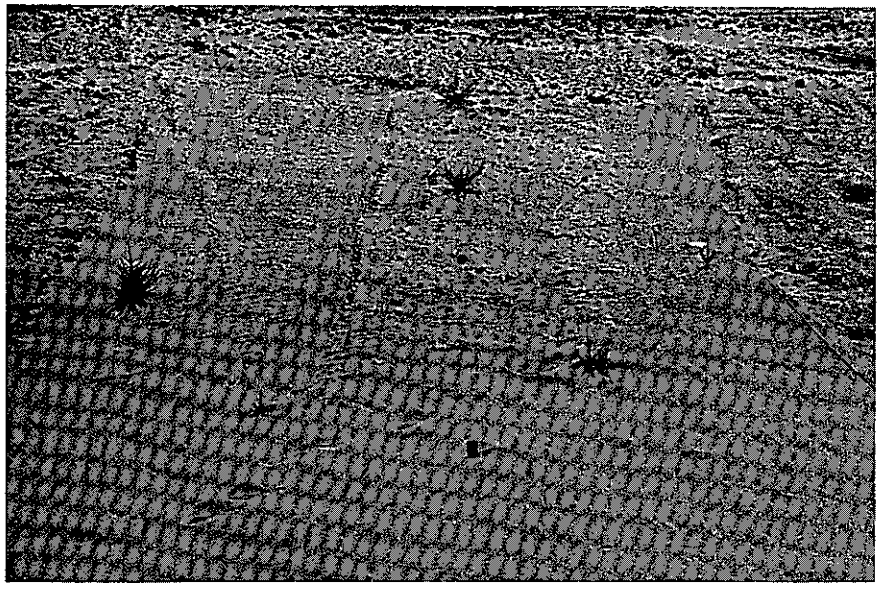


Plate 11 - Wind velocity and direction recording installation.



3-5-71 a.m.



Note motorcycle track 8-30-71 p.m.

Plate 12 - Control Plot

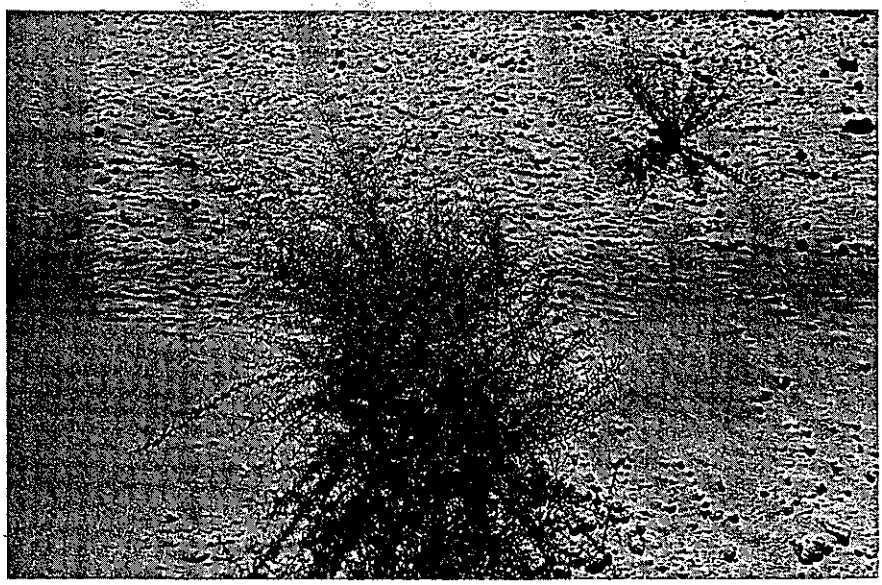


Plate 13 - Native vegetation on one of the test plots.

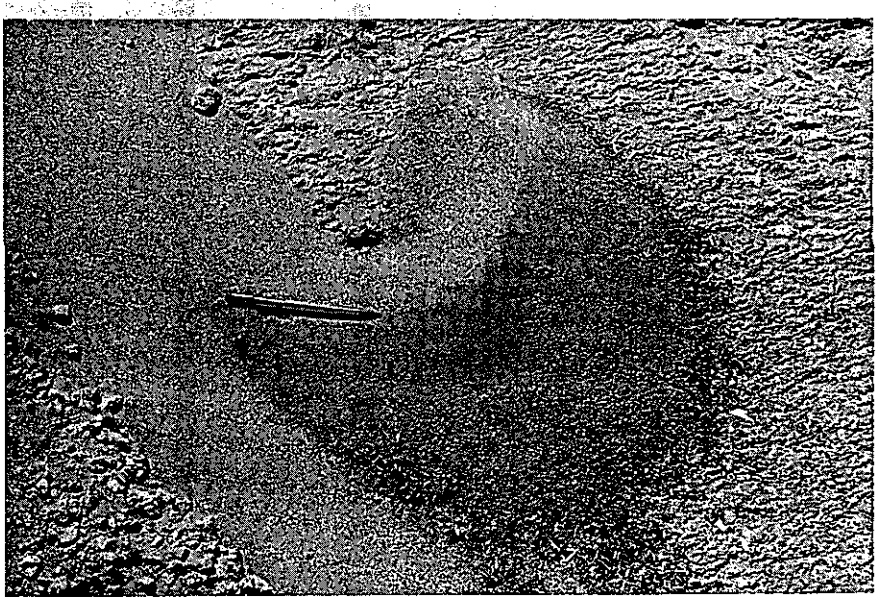
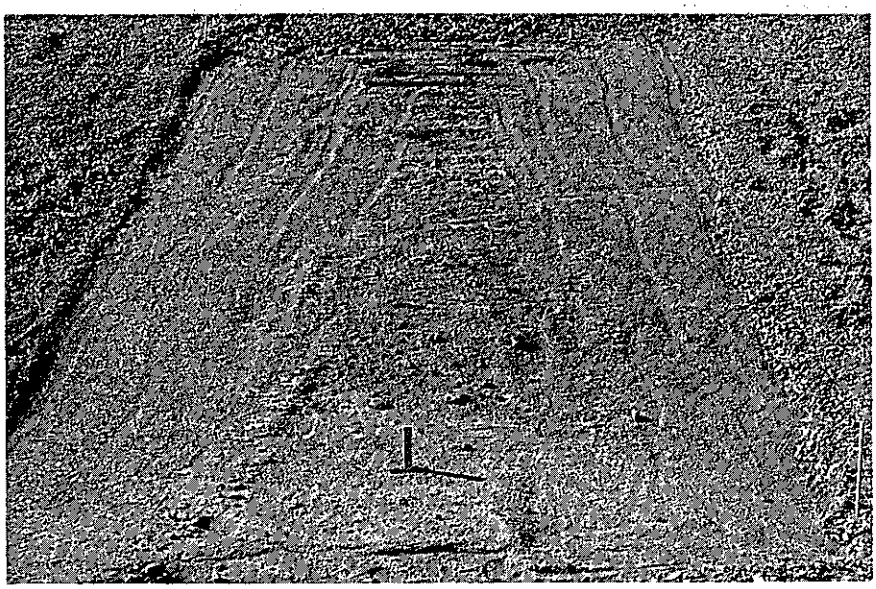
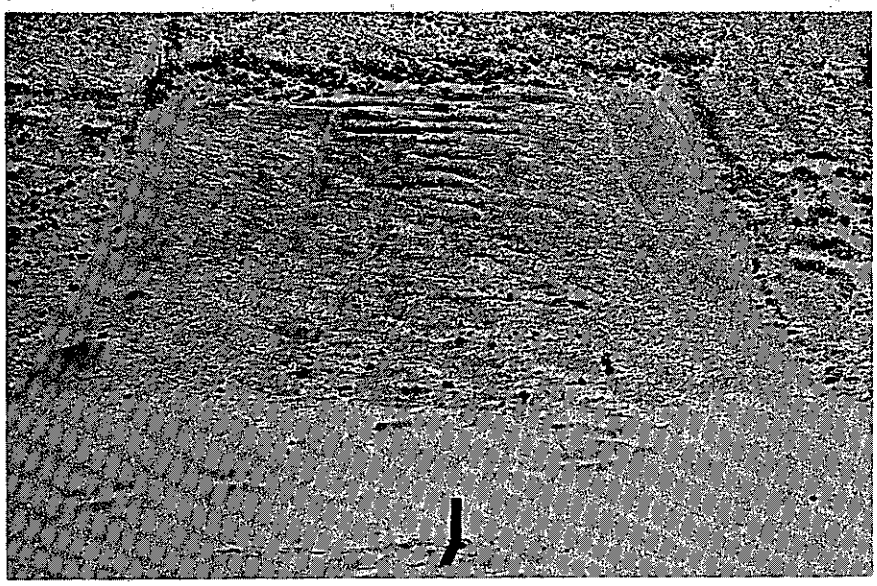


Plate 14 - Damage to test plot by burrowing insect.

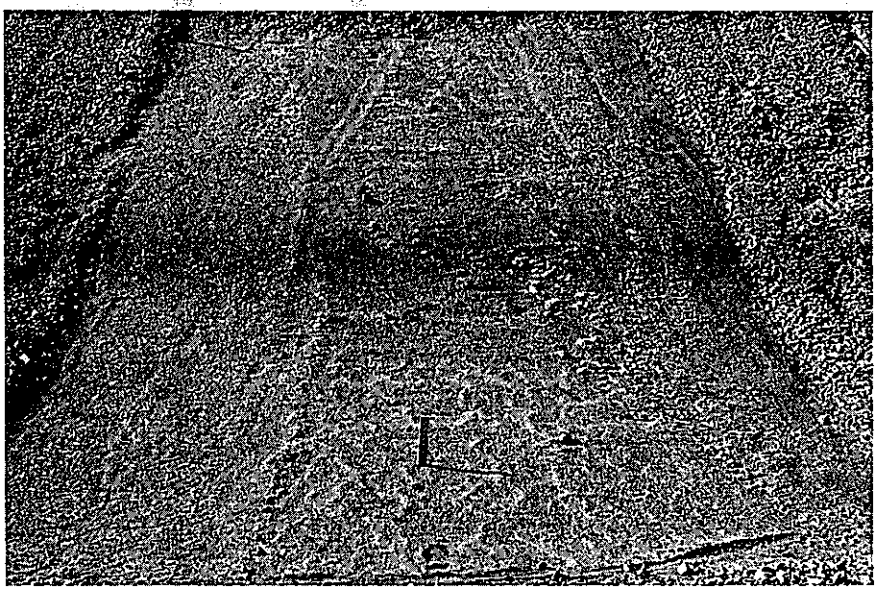


3-5-71 a.m.

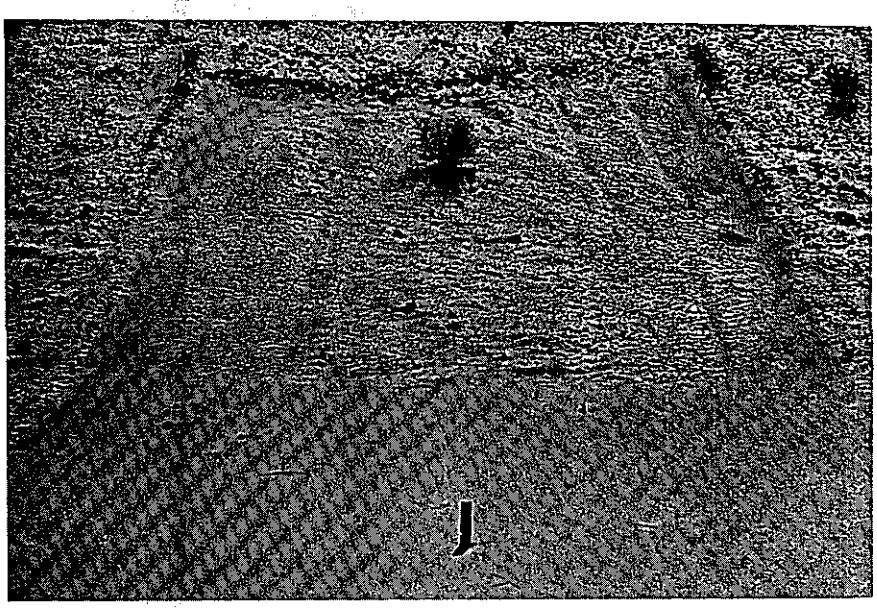


8-30-71 p.m.

Plate 15 - Aerospray 52



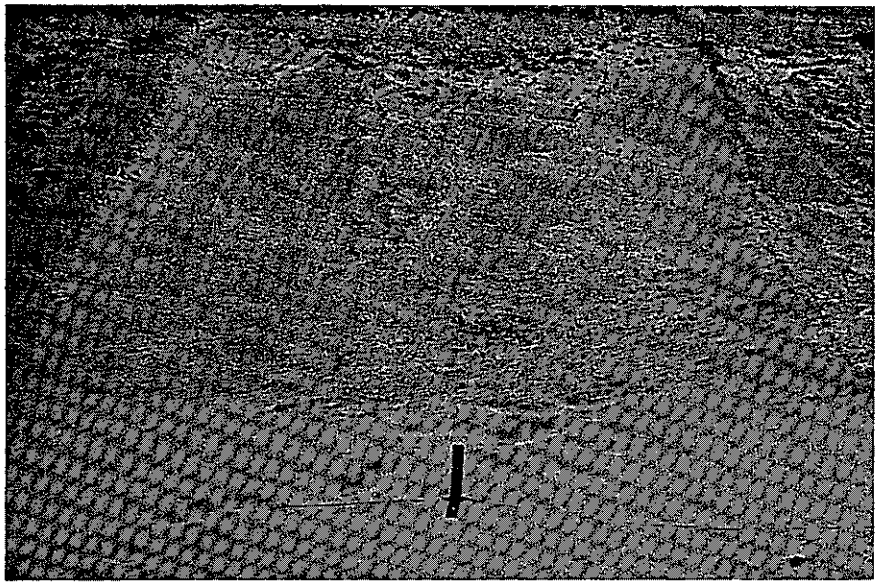
3-5-71 a.m.



8-30-71 p.m.

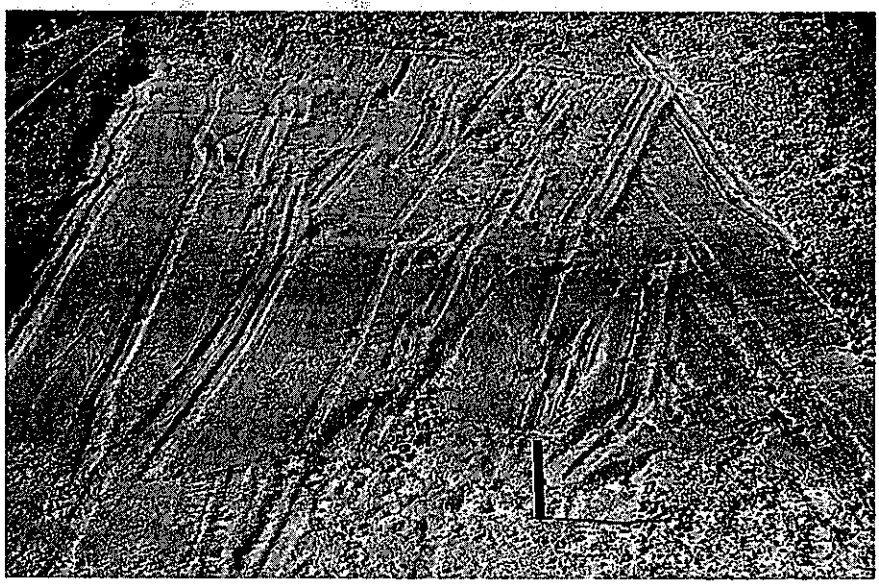
Plate 16 - Aerospray 52

3-5-71 a.m.

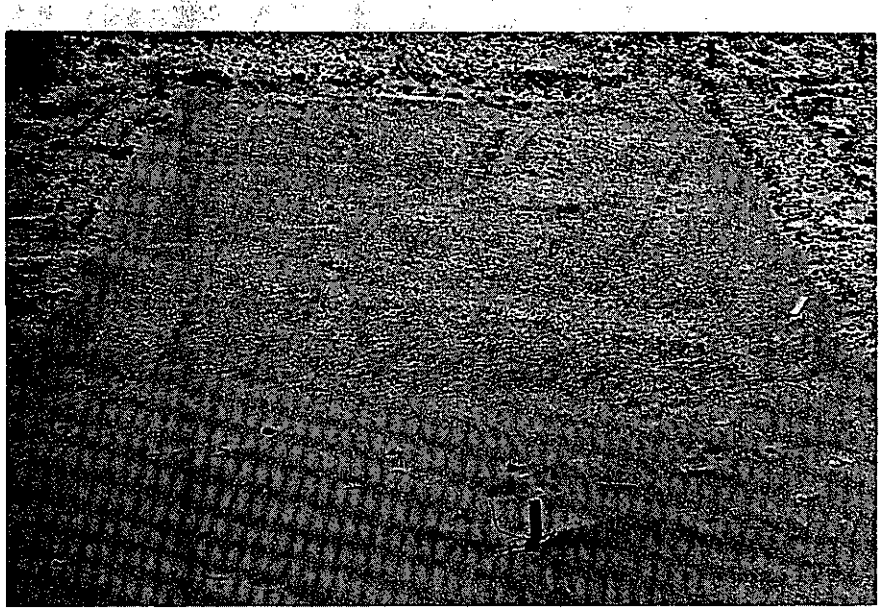


8-30-71 p.m.

Plate 17 - Aquatain

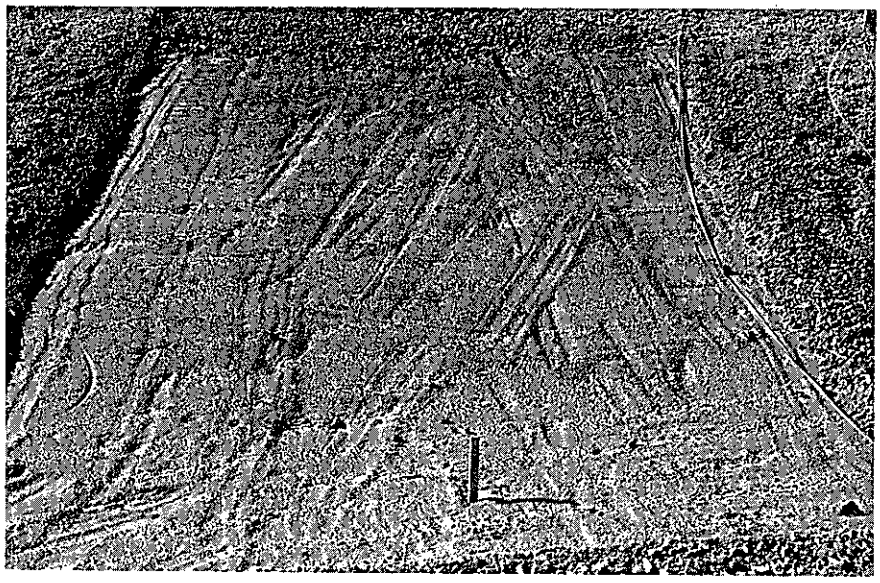


3-5-71 a.m.

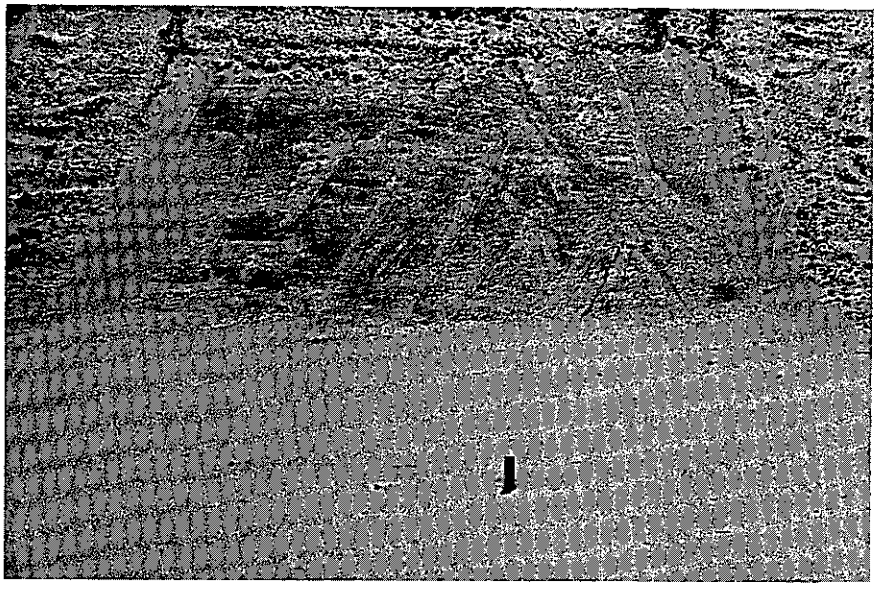


8-30-71 p.m.

Plate 18 - Aquatain

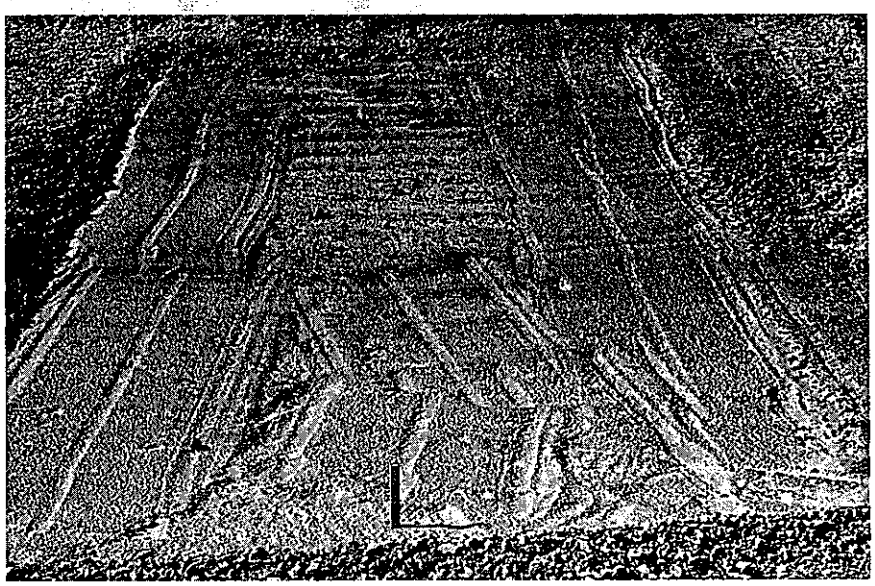


3-5-71 a.m.

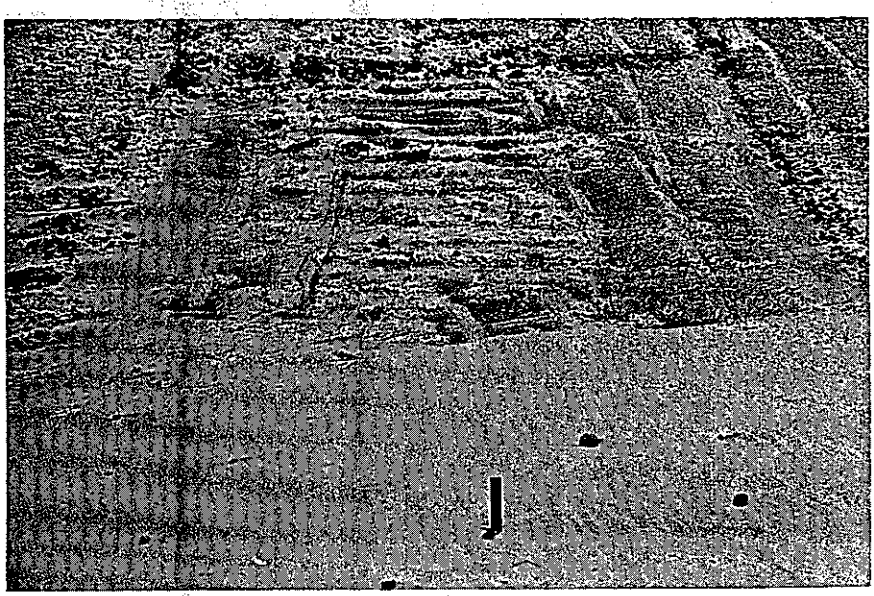


8-30-71 p.m.

Plate 19 - Coherex

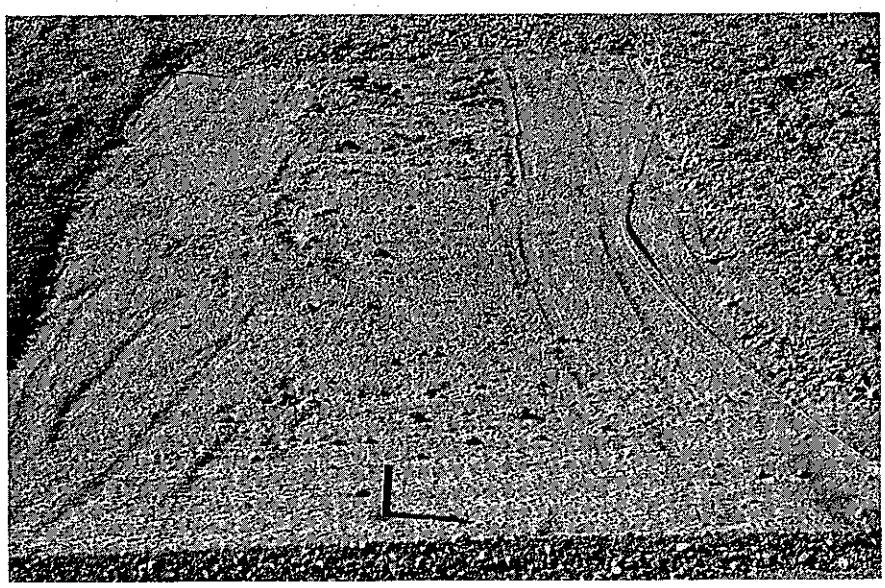


3-5-71 a.m.

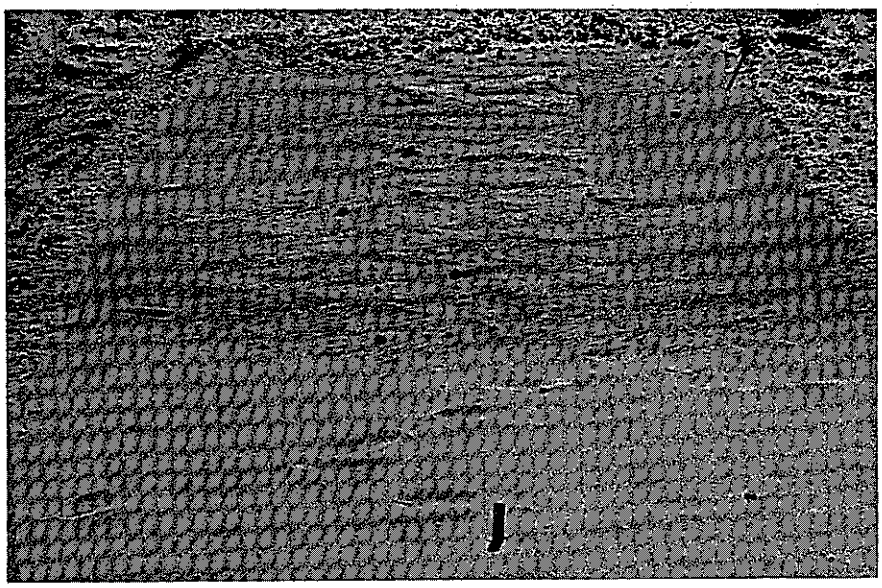


8-30-71 p.m.

Plate 20 - Coherex



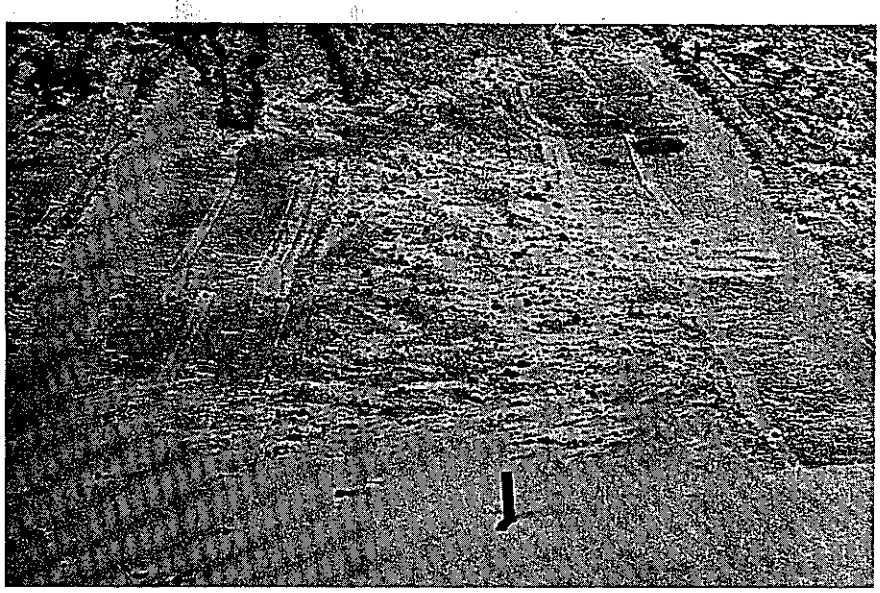
3-5-71 a.m.



8-30-71 p.m.

Plate 21 - Conwed Fiber

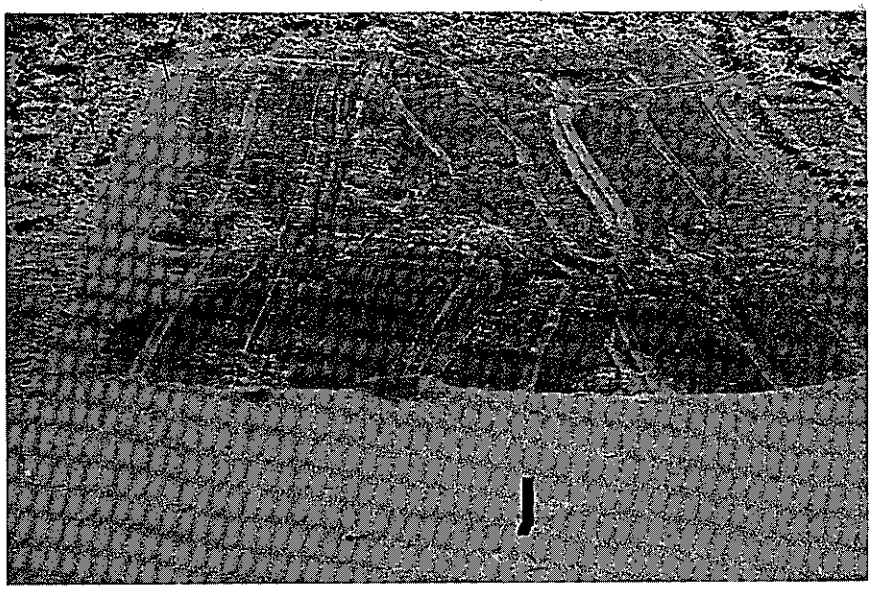
3-5-71 a.m.



8-30-71 p.m.

Plate 22 - Curasol AE

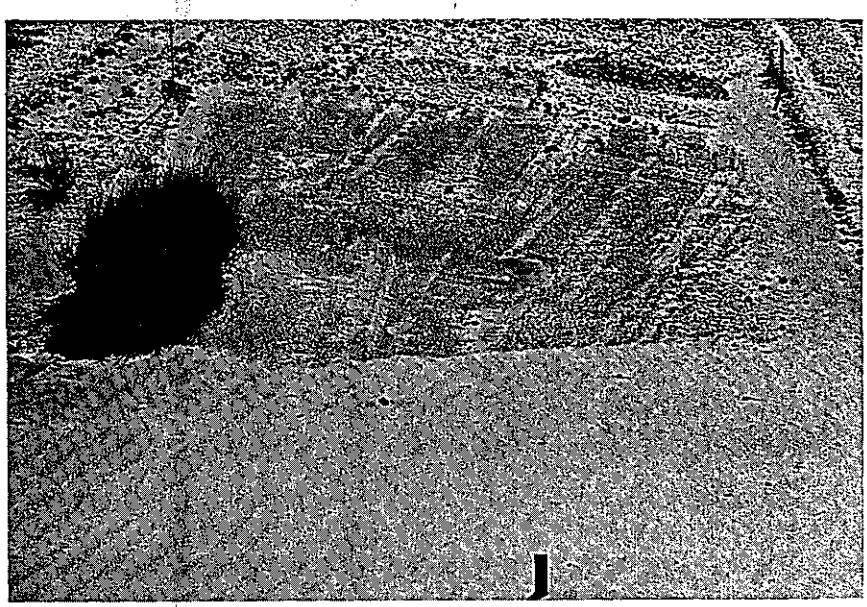
3-5-71 a.m.



8-30-71 p.m.

Plate 23 - Curasol AE

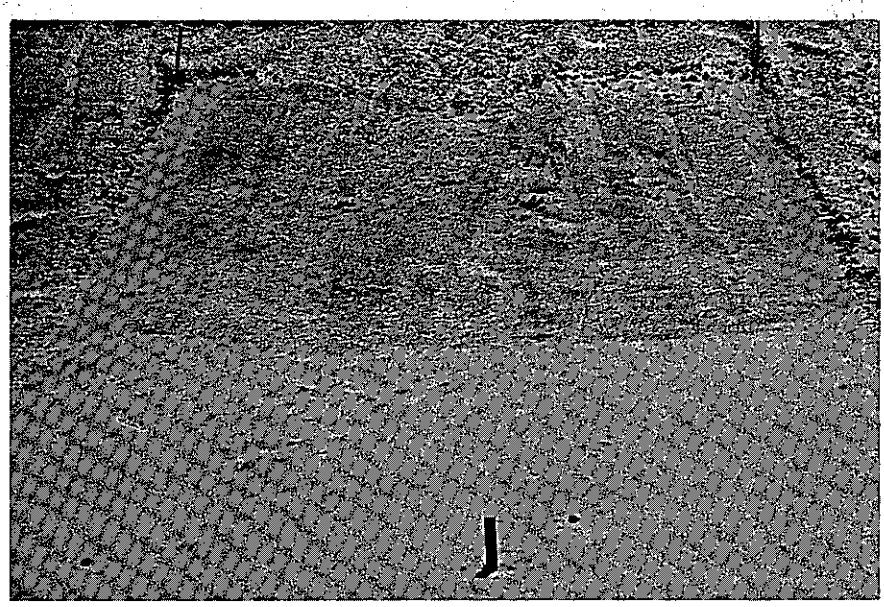
3-5-71 a.m.



8-30-71 p.m.

Plate 24 - Curasol AH

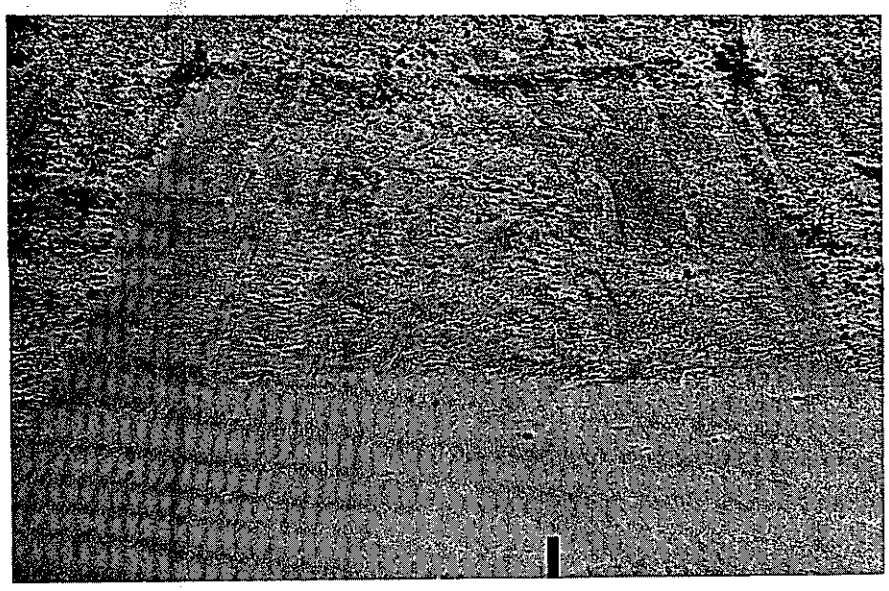
3-5-71 a.m.



8-30-71 p.m.

Plate 25 - Ecology Control

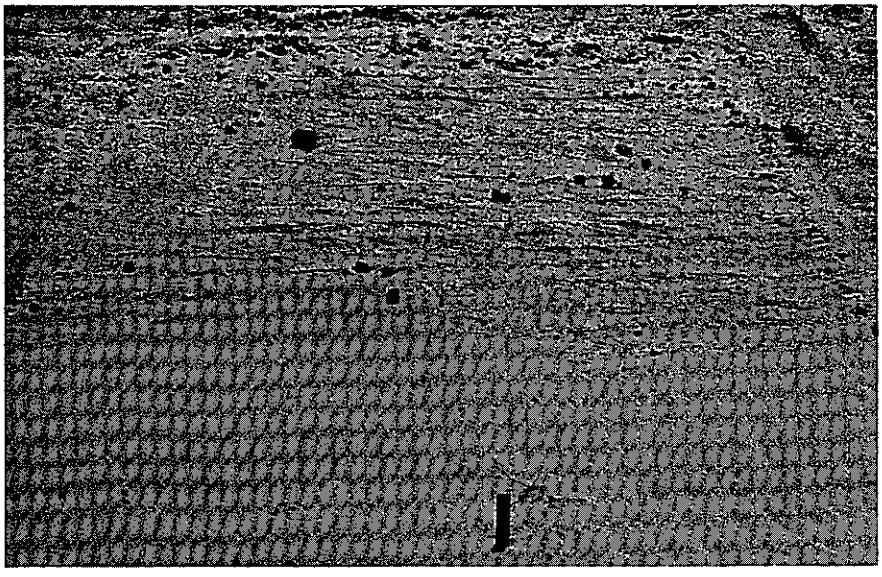
3-5-71 a.m.



8-30-71 p.m.

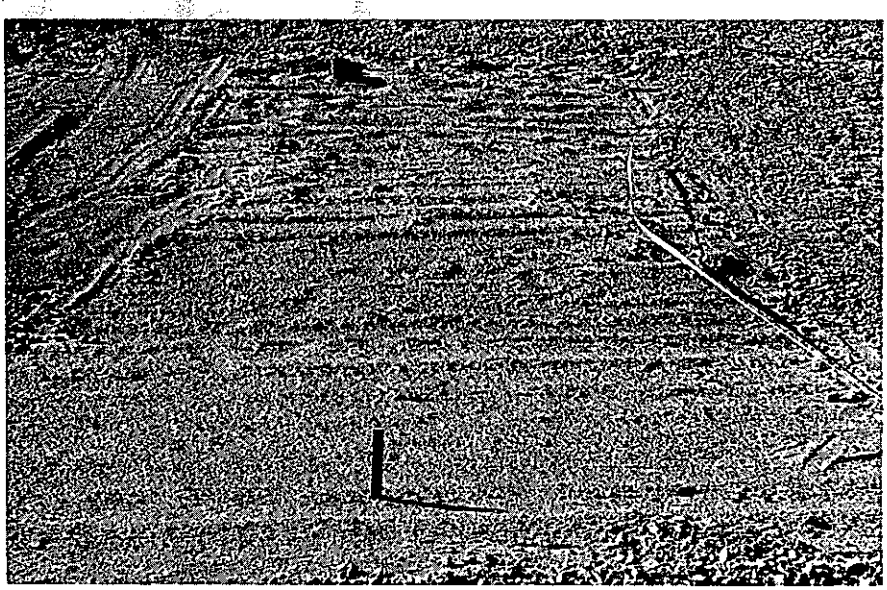
Plate 26 - Ecology Control

3-5-71 a.m.

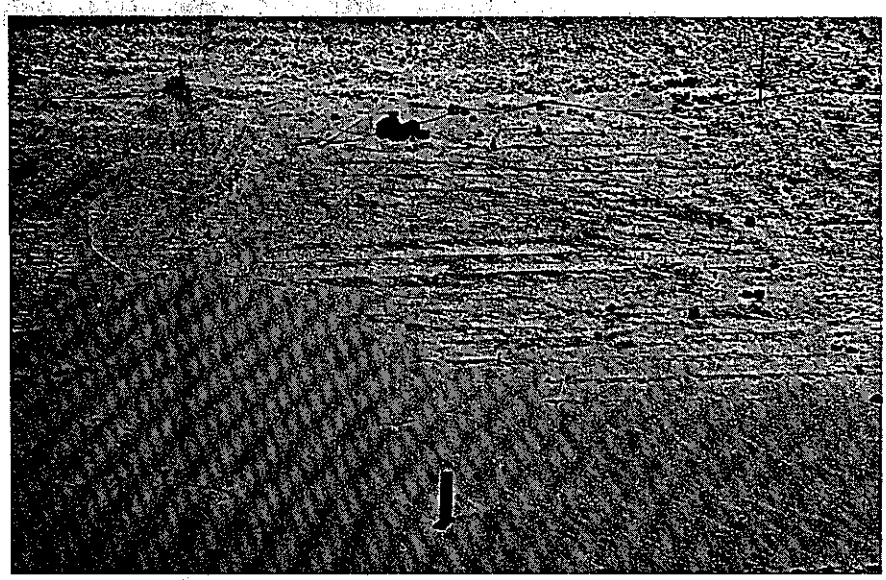


8-30-71 p.m.

Plate 27 - Erode-X

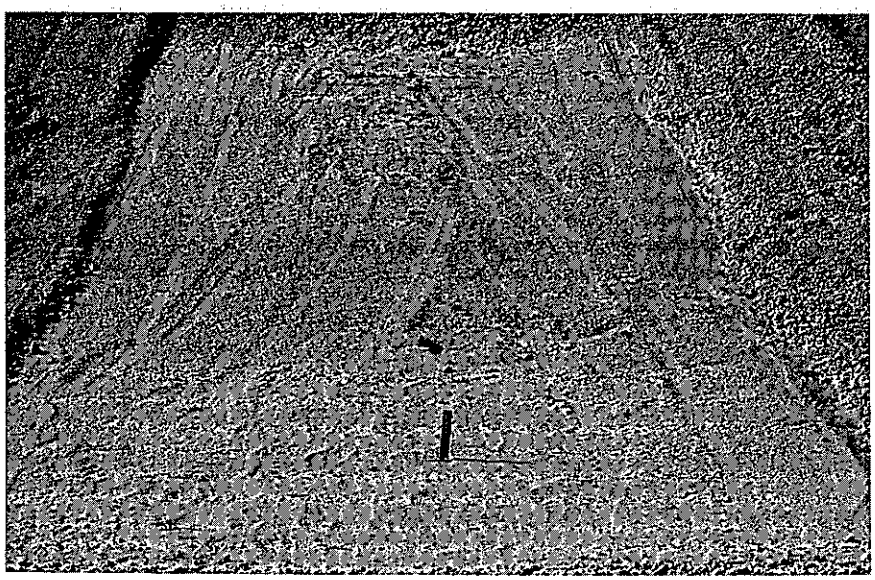


3-5-71 a.m.

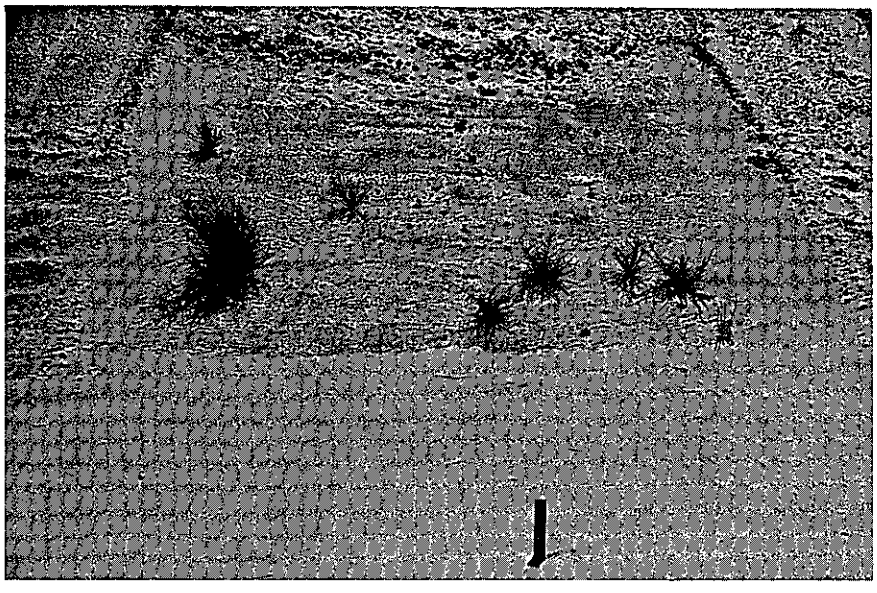


8-30-71 p.m.

Plate 28 - Erode-X



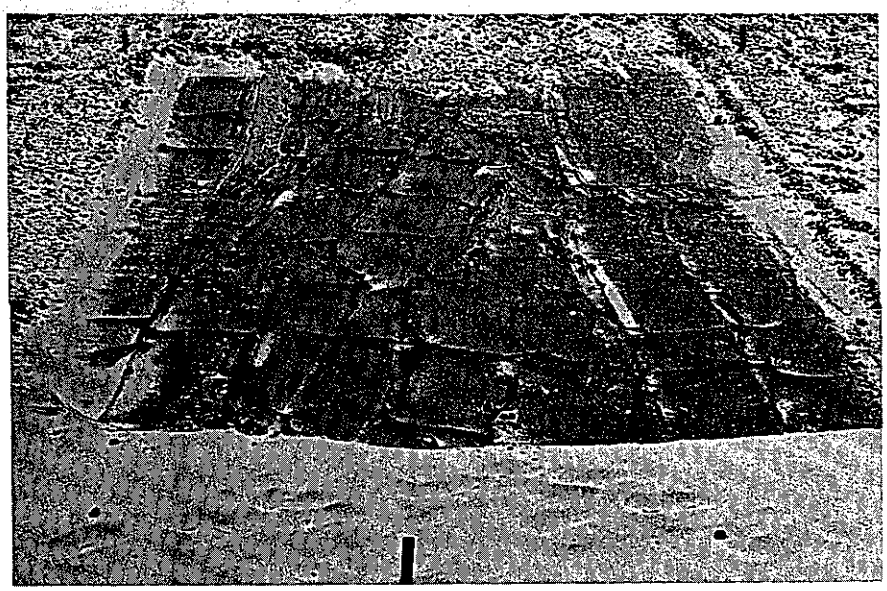
3-5-71 a.m.



8-30-71 p.m.

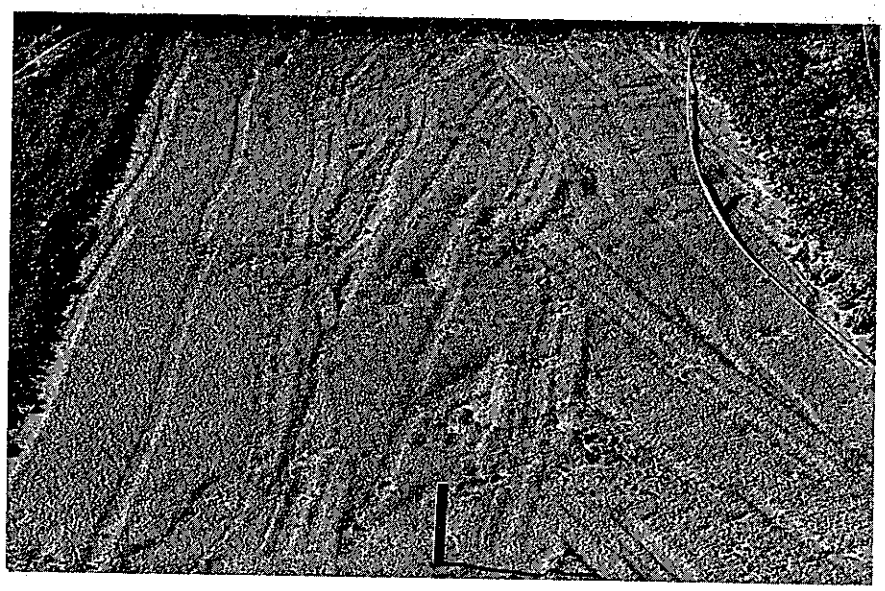
Plate 29 - Glenkote

3-5-71 a.m.

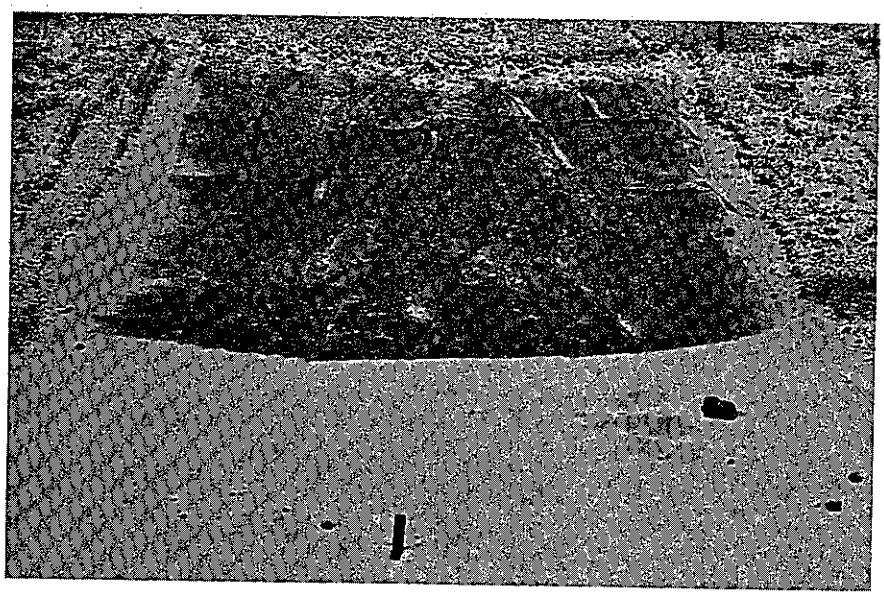


8-30-71 p.m.

Plate 30 - Orzan

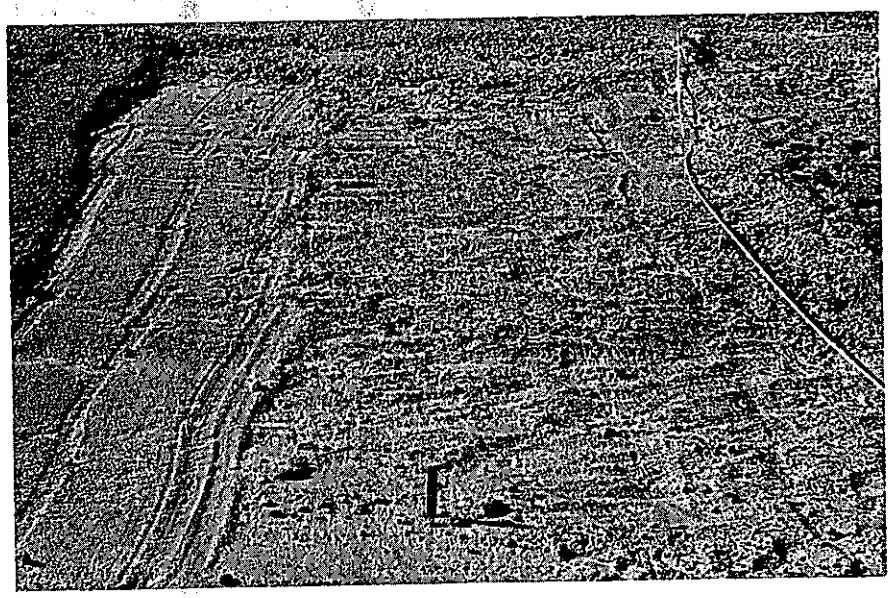


3-5-71 a.m.

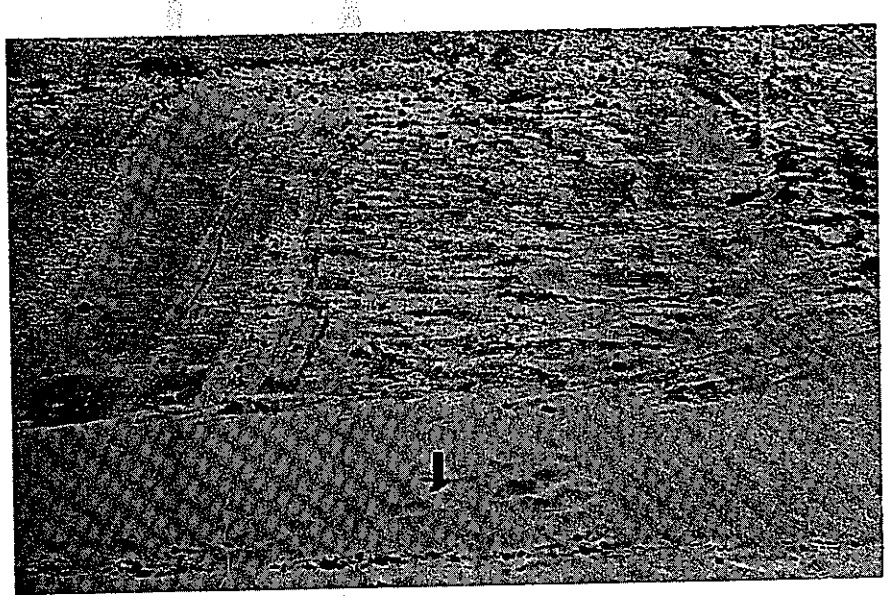


8-30-71 p.m.

Plate 31 - Orzan

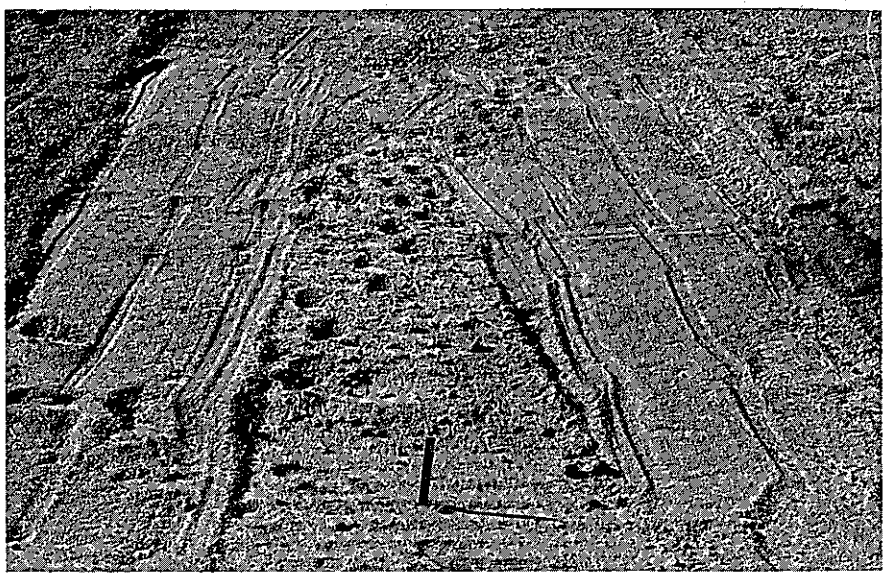


3-5-71 a.m.

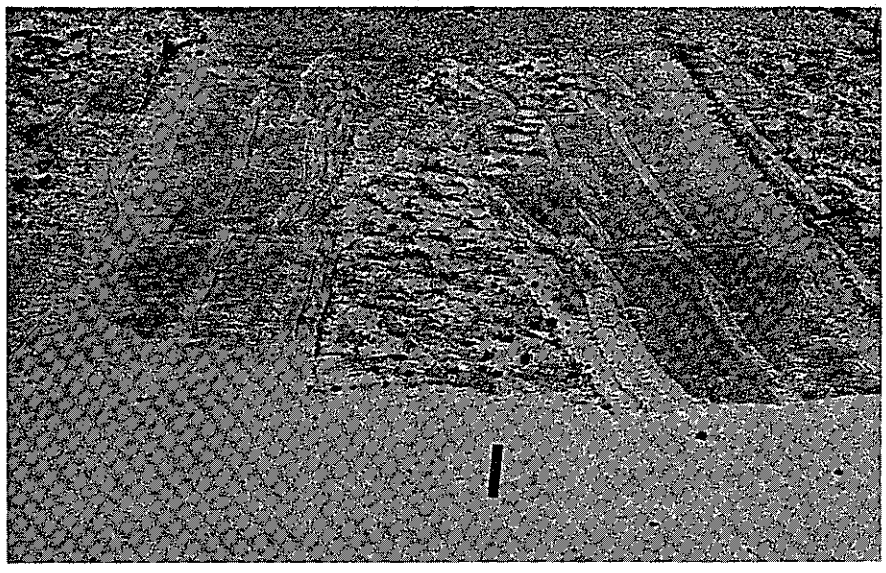


8-30-71 p.m.

Plate 32 - Soilmaster

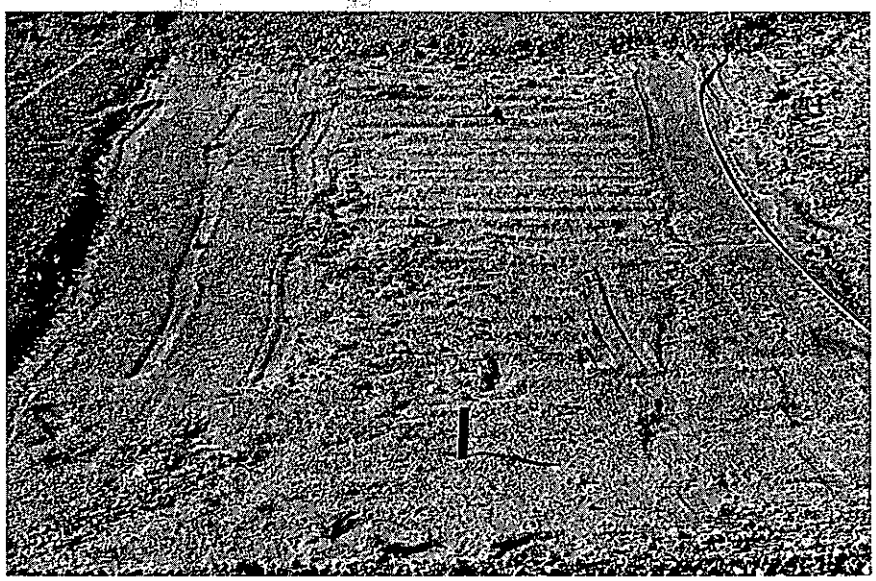


3-5-71 a.m.

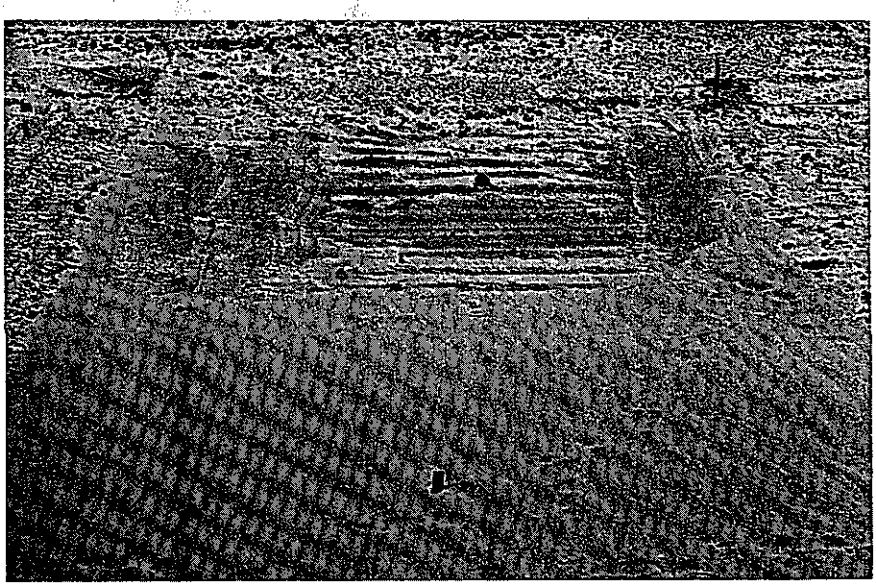


8-30-71 p.m.

Plate 33 - Soilmaster

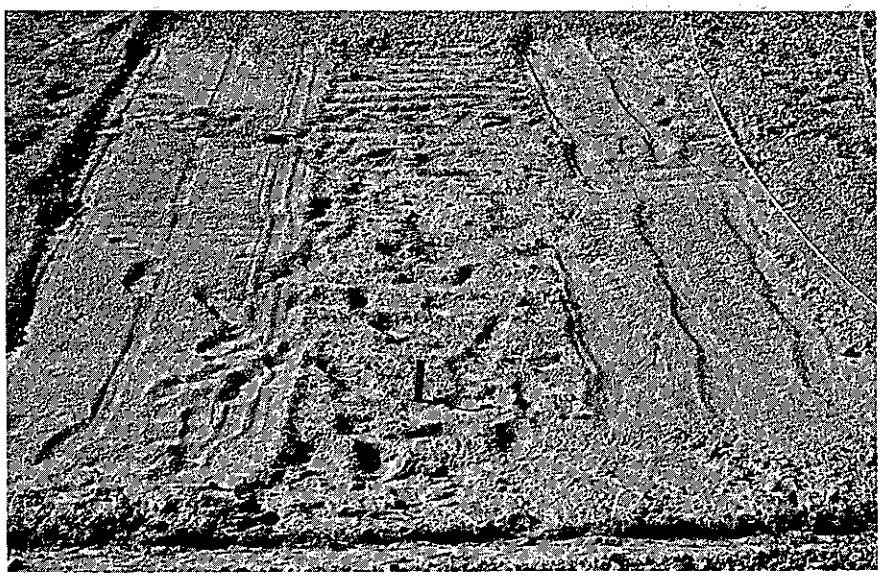


3-5-71 a.m.

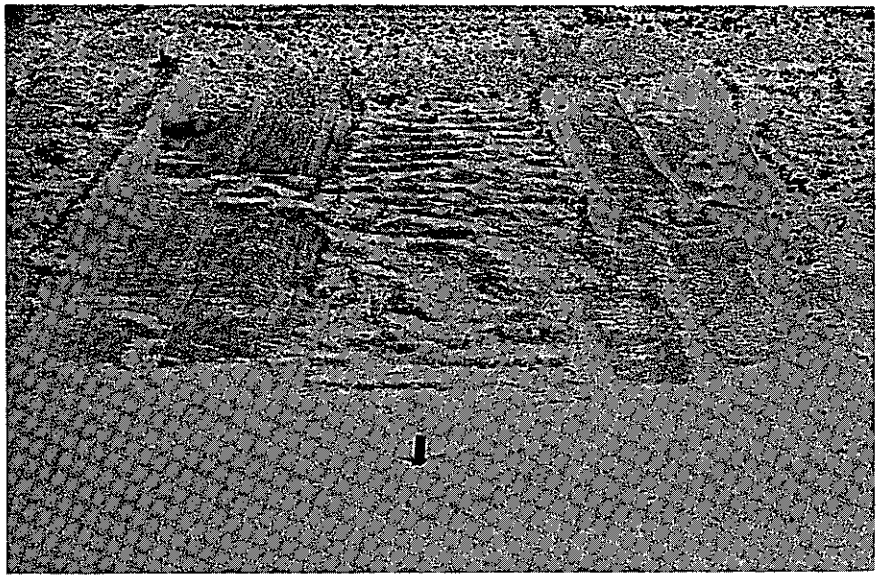


8-30-71 p.m.

Plate 34 - Soil Seal

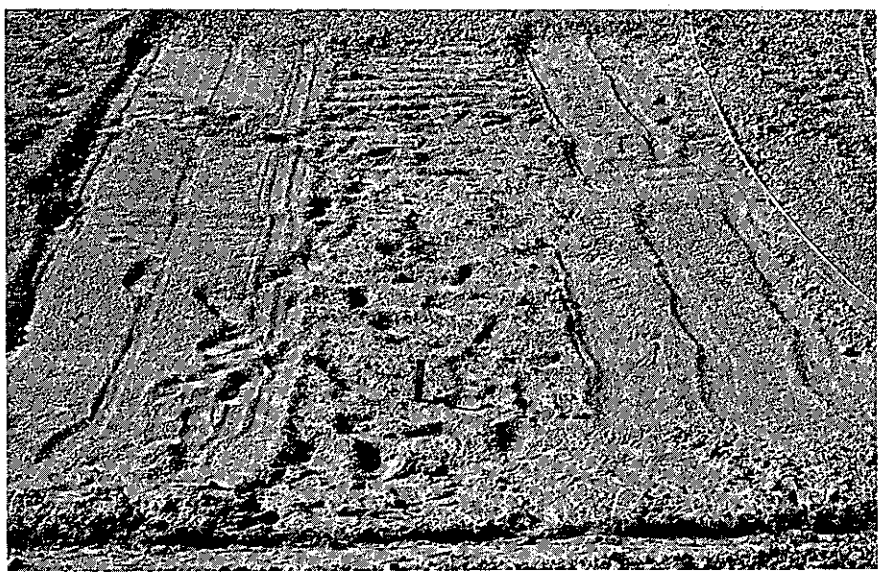


3-5-71 a.m.

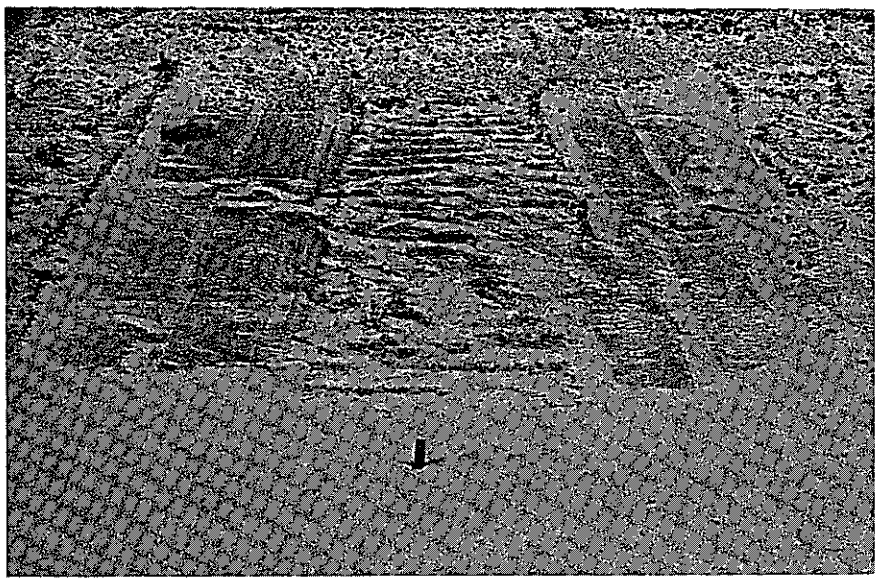


8-30-71 p.m.

Plate 35 - Soil Seal

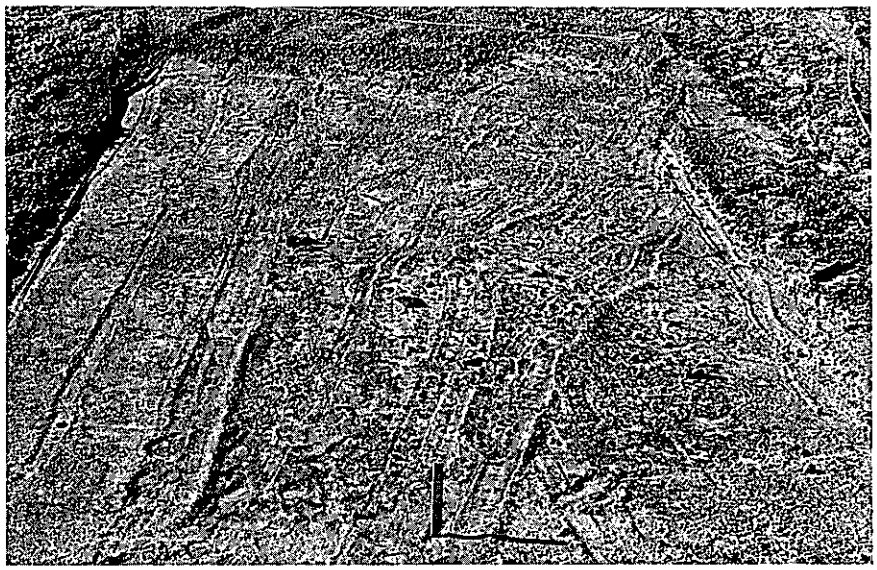


3-5-71 a.m.

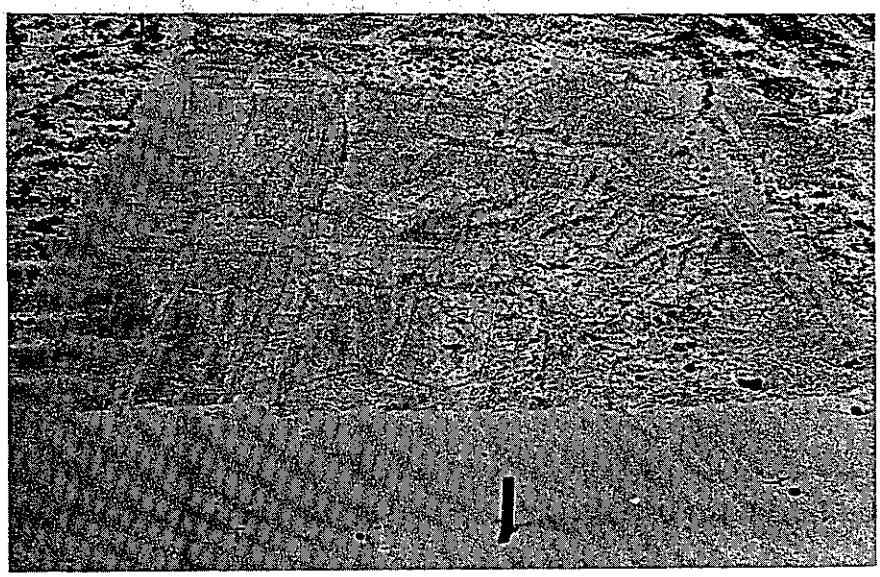


8-30-71 p.m.

Plate 35 - Soil Seal



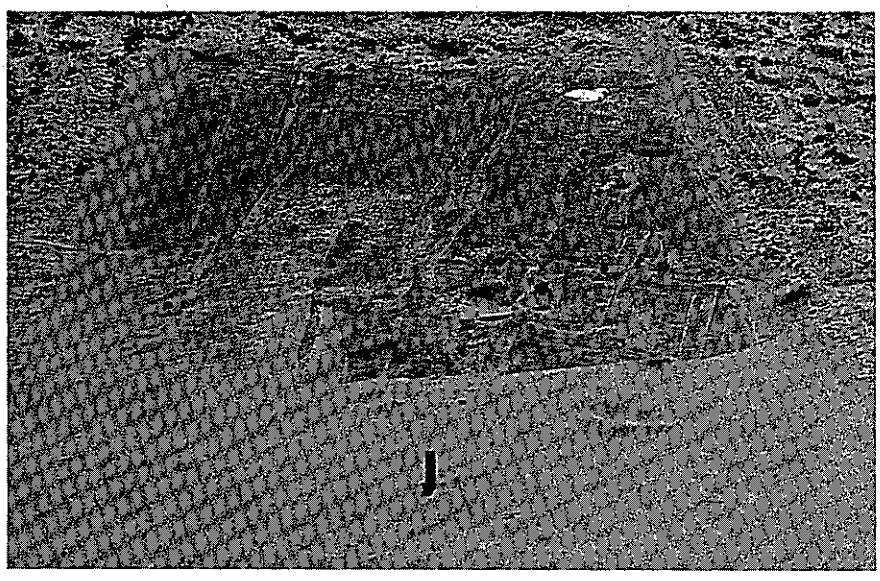
3-5-71 a.m.



8-30-71 p.m.

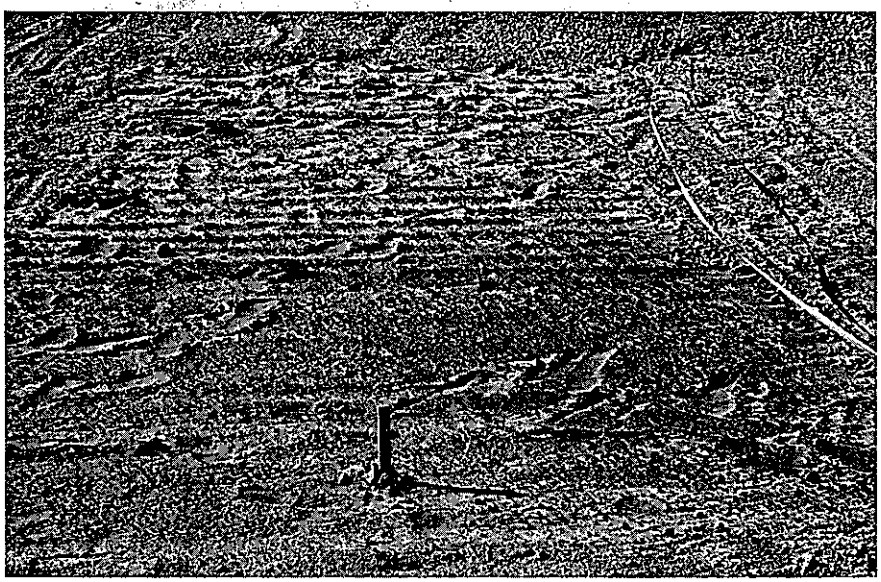
Plate 36 - Soil-Lok

3-5-71 a.m.

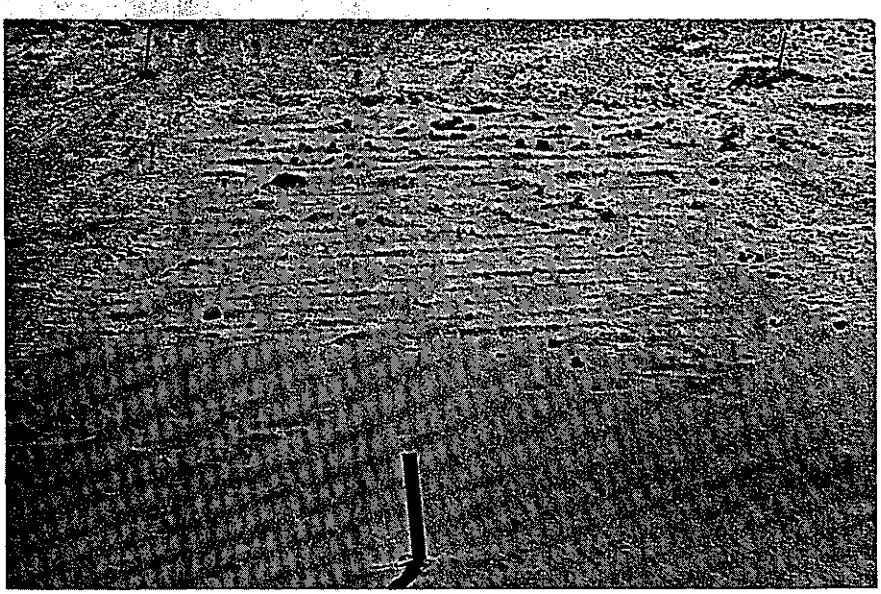


8-30-71 p.m.

Plate 37 - Soil-Lok

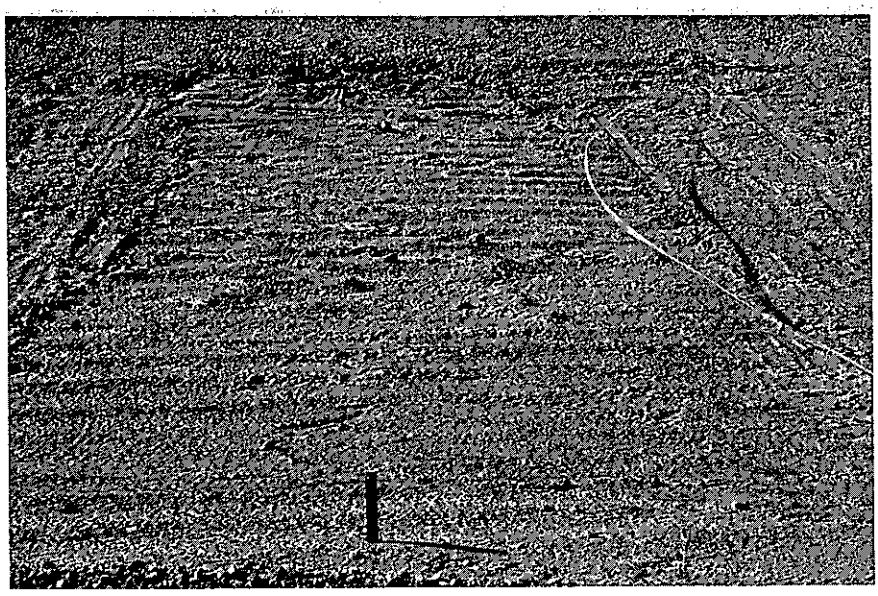


3-5-71 a.m.

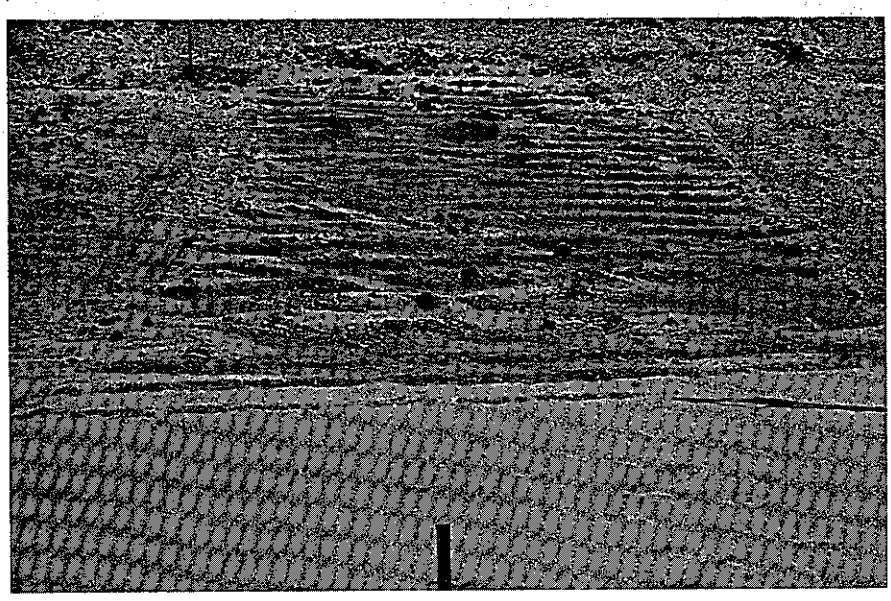


8-30-71 p.m.

Plate 38 - Surfaseal



3-5-71 a.m.



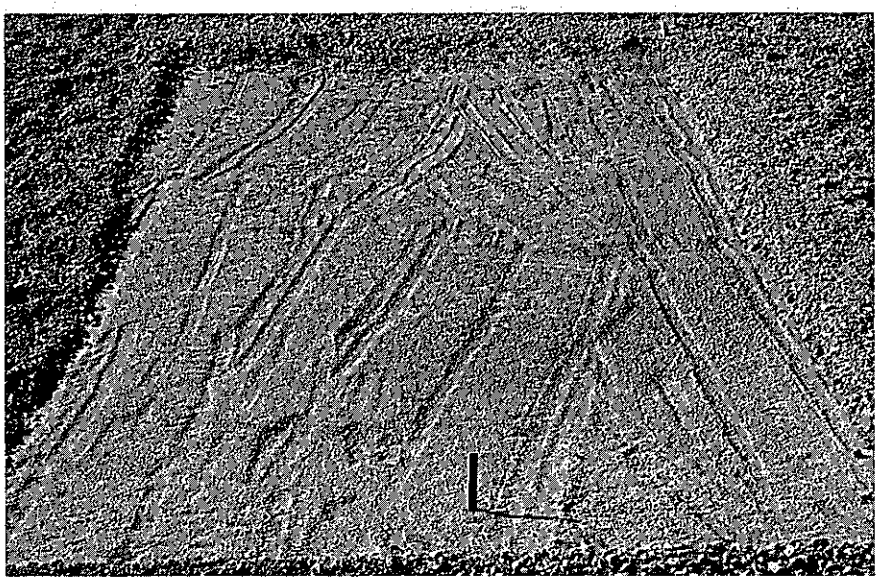
8-30-71 p.m.

Plate 39 - Surfaseal

3-5-71 a.m.

8-30-71 p.m.

Plate 40 - Terra-Krete



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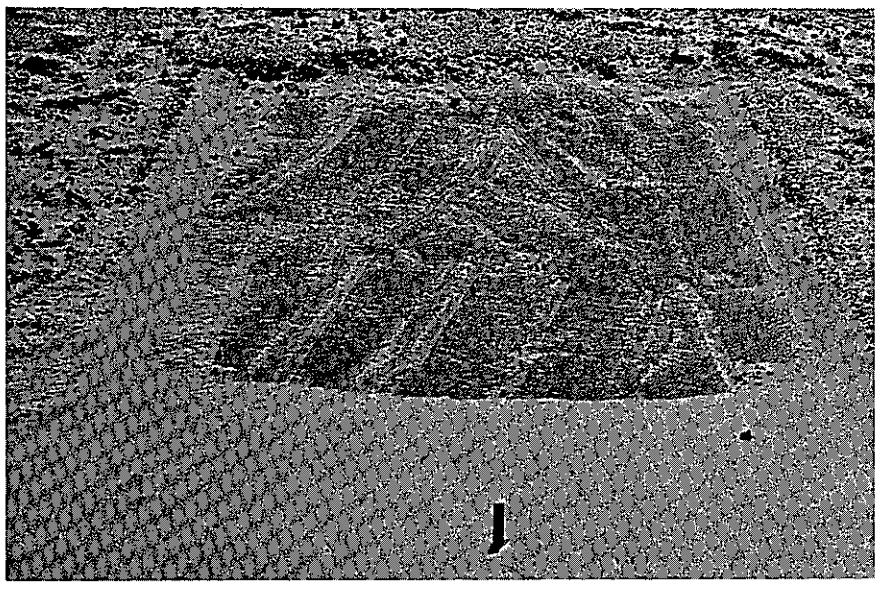
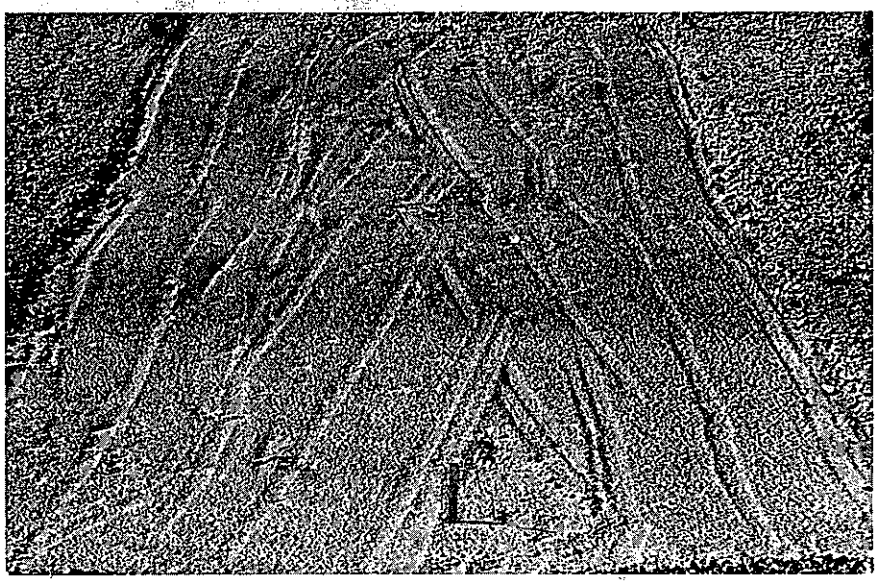
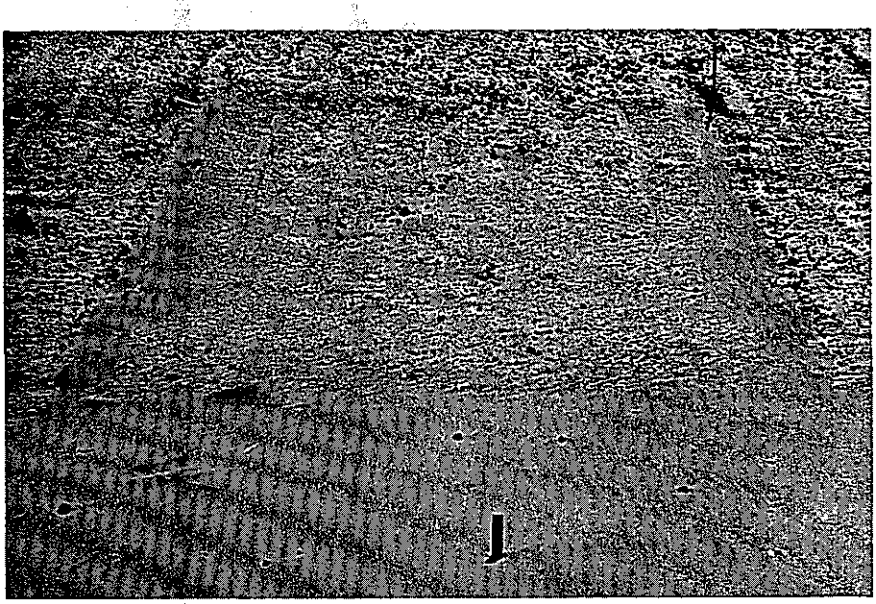


8-30-71 p.m.

Plate 41 - Terra-Krete



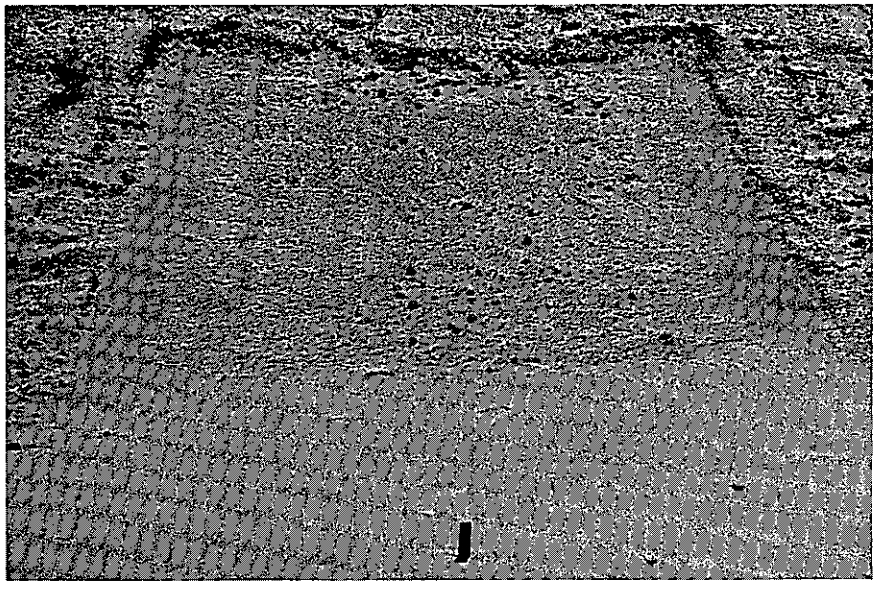
3-5-71 a.m.



8-30-71 p.m.

Plate 42 - Verdyol (Super)

3-5-71 a.m.



8-30-71 p.m.

Plate 43 - Verdyol (Super)